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Radio-linked sound installation provides essential communication on mechanized refrigerator-car icing operation.

Page 77

How to estimate man-hours and job-expense costs on small street, yard or park lighting installations.

Page 80

Four methods to solve motor starting and transient voltage drop problems on modern industrial distribution systems.

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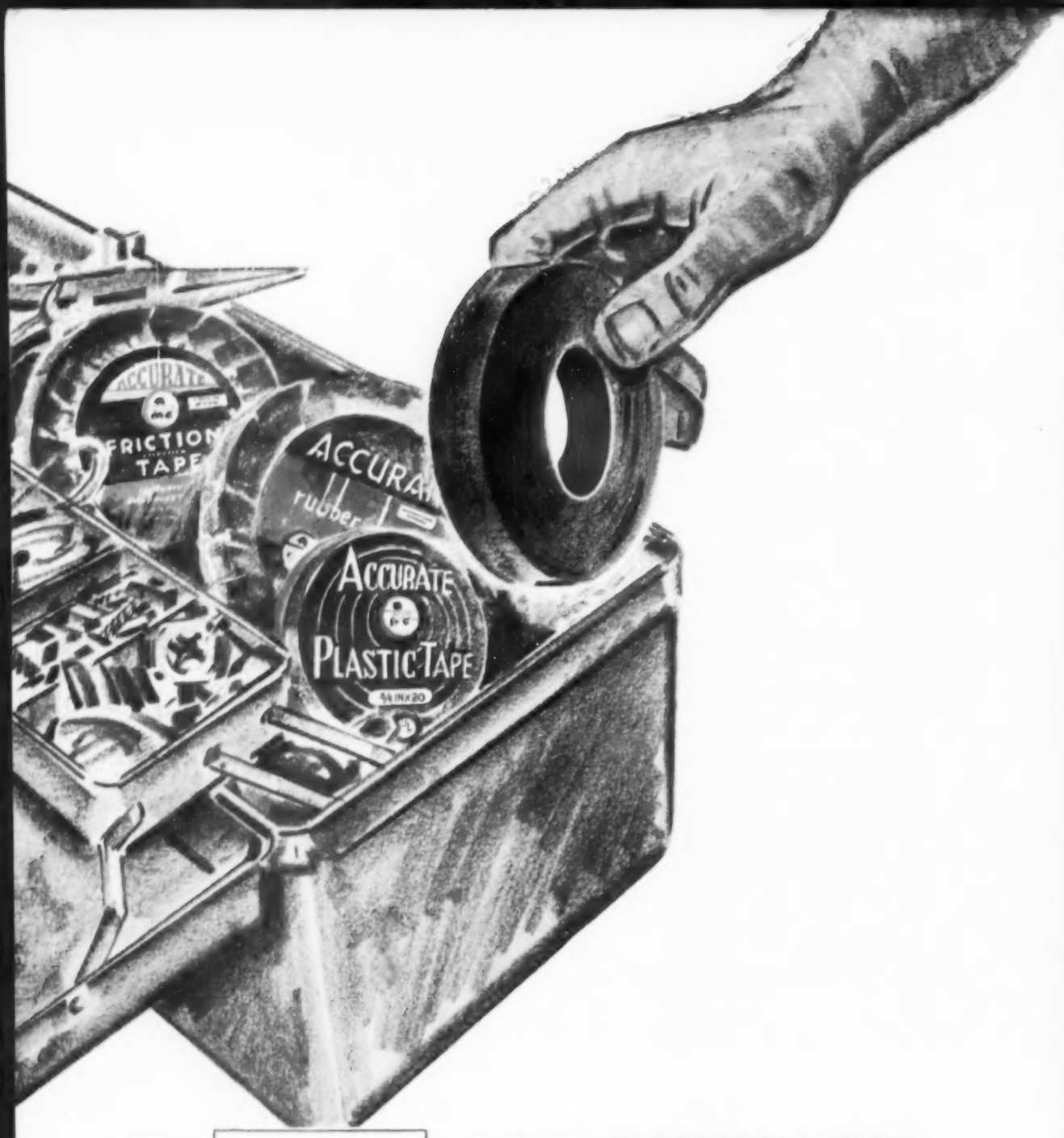
A McGRAW-HILL PUBLICATION

55TH YEAR



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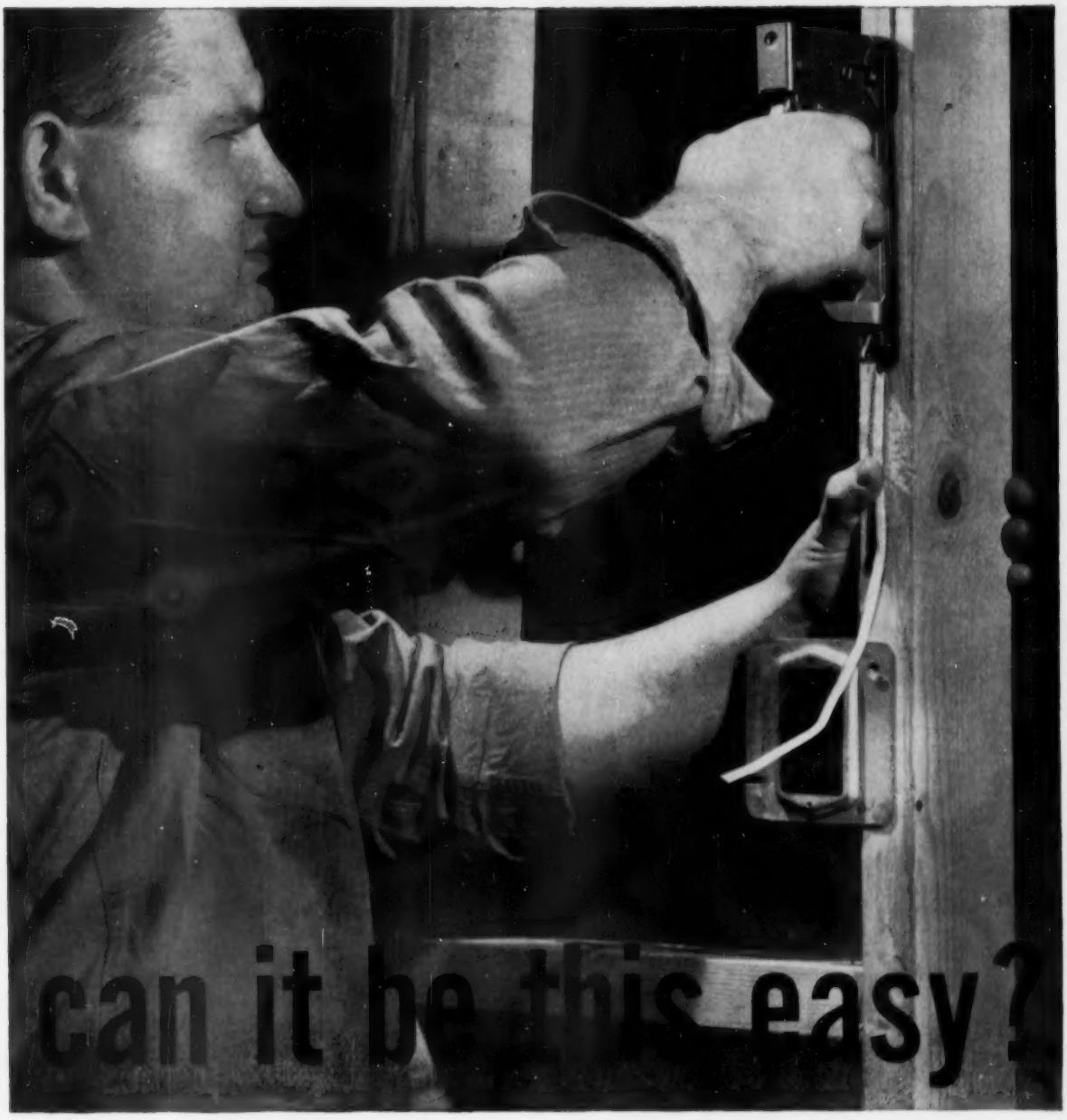

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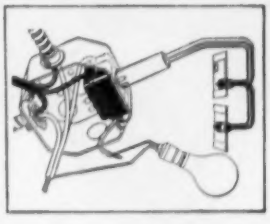

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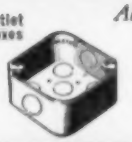

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—Sidelights—

SKYSCRAPER – Modern American skyscrapers are creating design trends affecting major construction throughout the world. They represent in electrical design and installation the advanced planning of leading engineers and the advanced methods of leading electrical contractors. What these broad trends are and what they signify are discussed by Harry C. MacNary, V.P., Fischbach and Moore, Inc., in "Electrical Design Trends in American Skyscrapers", page 88.

LOW-VOLTAGE SWITCHING–A new low-voltage switching device, recently marketed, employs a novel independent transformer-relay with control plates carrying up to five wall switches. The sytem was applied to a Scarsdale residence by Whiffen Electric of White Plains to achieve an extensive multi-point switching layout. Details of the job are given in "Case Study in Low-Voltage Switching" beginning on page 93.

MOTOR STARTING–Starting large motors may produce undesirable transient conditions on industrial electrical distribution systems. Many of the problems encountered can be solved, however, by the proper selection and application of motor starting equipment. Practical methods are described by H. W. Cory of Allis Chalmers in his article, "Motor Starting Problems on Industrial Distribution Systems" beginning on page 106.

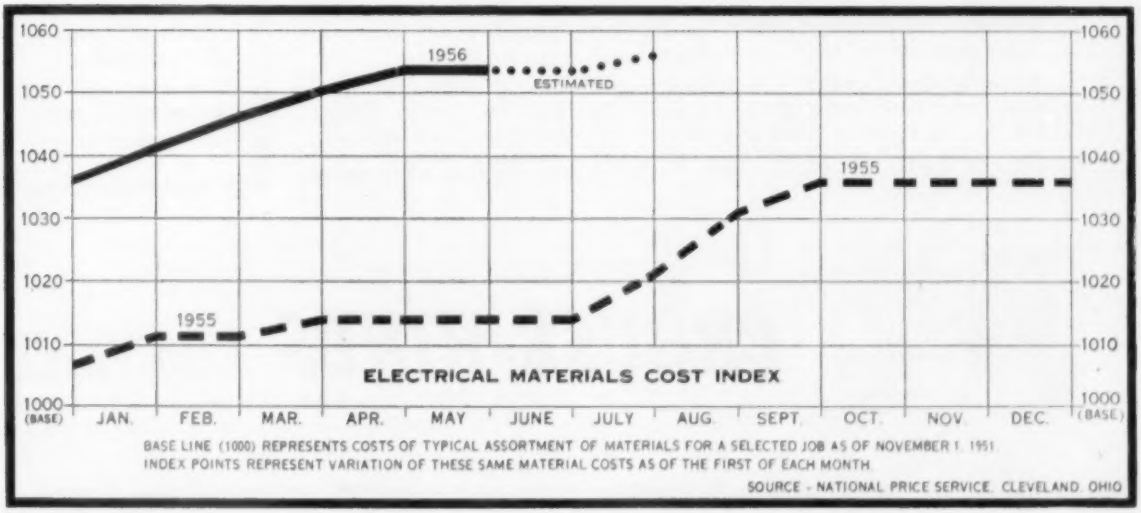
AWARD OF MERIT–In the 18th annual editorial competition conducted by Industrial Marketing, *Electrical Construction and Maintenance* won an Award of Merit for Editorial Excellence in the Industrial Paper classification for "best single issue". The editorial project which won the citation of the judges was the May 1955, "Electrical Specifications".

REGRETS–Requests for additional copies of the May issue editorial feature, "Modern Electrical Systems Design", far exceeded what we anticipated. A large number of extra copies were prepared during the original printing to provide for such requests. Within one day of the issue mailing, orders began to arrive for such quantities that we found it necessary to impose drastic limits. In spite of this precaution, the number of individual orders quickly exhausted the entire supply. We regret that no more copies are available.

BUSINESS BUILDERS–Daylight reflections in store windows are a bane of merchandising. Attempts at correction by high intensity lighting have been only partially effective. Bill Cyr, Western Consultant, informs us that recent experiments on the Coast with luminous back panels in show windows have proved spectacularly successful, have attracted wide attention, and look like an important new trend.

Garden lighting is enjoying a boom. Weatherproof outlets, UF cables with grounding wire and rigid conduit protection above ground are used for circuitry. Plenty of attractive fixture designs are on the market.

Watch educational TV! Recent installations are stirring much interest among school and college administrators. Make sure that outlets and raceways are provided in present and planned school construction in your area to facilitate the inevitable installation of these new closed-circuit TV devices.



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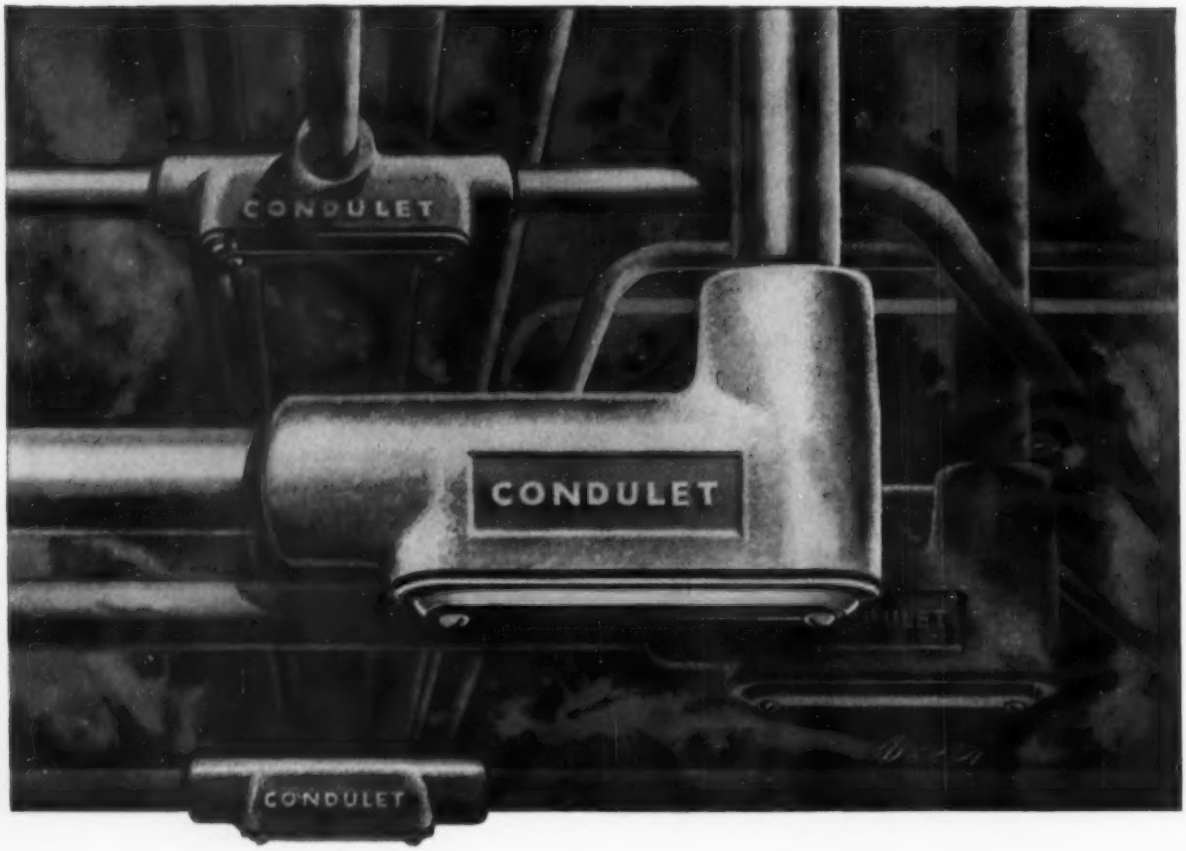

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Washington Report

Overall business outlook for next six months is for gradual upturn from the high plateau which already exists. Currently there are some economic soft spots—an auto slump; lagging farm machinery sales; poor textile business; price downturn on copper, rubber, steel scrap, etc; keener competition in home appliances; lagging housing starts; rising consumer debt, now nearly $36 billion. But economic weaknesses which in the main are down only slightly, are being offset by strong factors—strong demand for capital goods, such as machine tools, construction equipment, refractories, electric motors; rising output of electric power, petroleum, most chemicals; strong retail sales in most areas; continuing construction volume at or near record levels; record personal income and employment, and other major economic factors which now reflect slow but continued growth.

Washington officials are encouraged over a current upturn in demand for new autos even though buying stays some 20%-25% below last year's pace, while output holds to its slower pace. Also noted is an increasing number of applications for new housing loans and GI-housing appraisals. While housing starts seem sure to end up under last year's 1.3 million total, HHFA Administrator Cole reports the Government has "plans" under consideration (details not disclosed) to help reach a similar target this year.

Senate Banking Committee voted to extend Defense Production Act for two more years, through June 30, 1958, (after the House passed a similar bill,) enabling Government to exercise priority and allocation powers, and undertake various industry mobilization agreements that would otherwise violate anti-trust laws.

New construction spending in May rose to $3.7 billion, to equal last year's May record, and topped April volume by 9%, Commerce and Labor Depts. reported. Total for year through May was $15.8 billion, compared with $15.6 billion for first five months of last year. Private industrial building totaled $247 million in May, setting a new high for the third straight month. New May records were also set by commercial building, both private and public educational building, public utility construction, sewer and water facilities, highway construction and public service enterprises. Spending for private residential building in May totaled $1.3 billion, as compared with $1.4 billion in 1955.

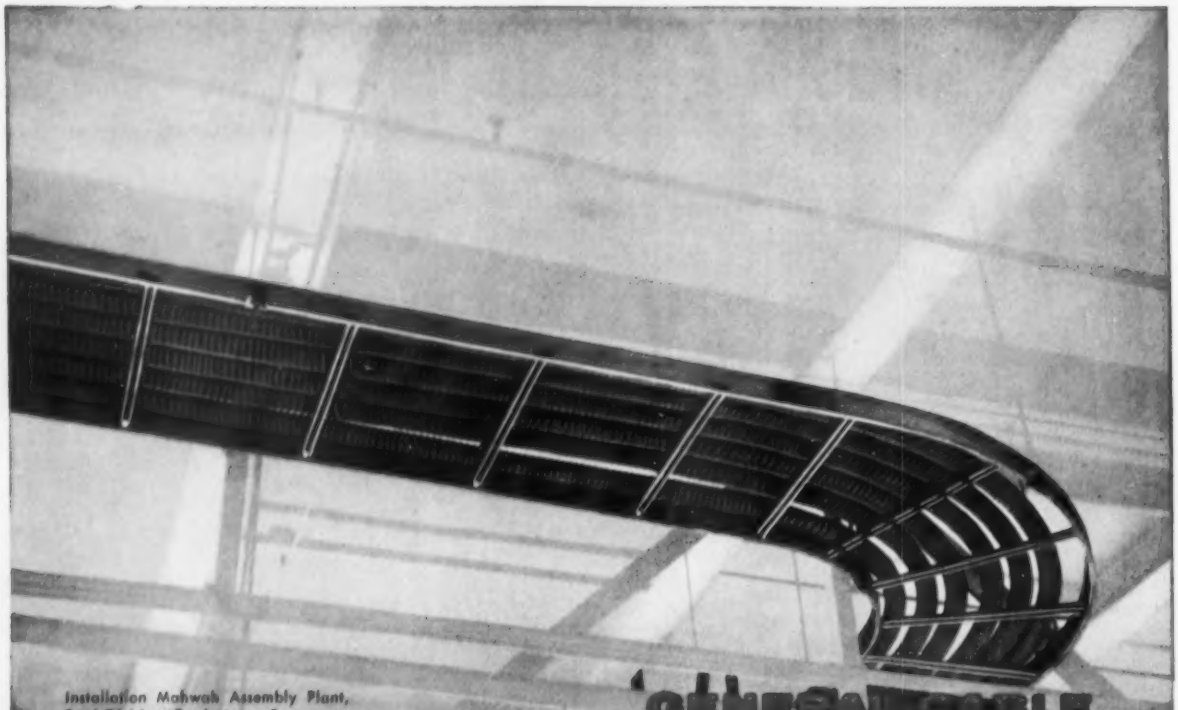
World copper prices sagged to near 40 cents per pound during June while U. S. producers held fast to the 46-cent level set in mid-February. Expectations were that U. S. producers would reduce prices to a level in line with world prices when they got a clear picture of customer needs for July.

Construction of three atomic power plants has been approved by Atomic Energy Commission: 1) Commonwealth Edison, Chicago—a $45 million plant; 2) Consolidated Edison, New York—a $55 million unit; and 3) Yankee Atomic Electric Co., New England—a $34.5 million project to be built at Rowe, Mass. The Commonwealth Edison and Consolidated Edison projects will be financed with private money. The Yankee Atomic project has AEC financing for research and development up to $5 million, with additional costs of same and construction costs to be paid by the company. Yankee Atomic is a corporation set up by twelve New England public utilities which will buy and distribute the power generated by the new 134,000-kw plant.

Social Security income topped payments by $1.1 billion in the fiscal year ended June 30, 1955, trustees of the special fund reported to Congress recently. Payments to old age and survivors in fiscal 1955 were $4.4 billion, while income was $5.5 billion, and raised the fund's total assets on hand at the end of the fiscal year to $21.1 billion, the trustees said. Income climbed 11% over fiscal 1954, but disbursements increased 32%.

Man's average annual income in the U. S. hit a record $3400 last year, up $150 for the year, while women's income was $1,100, about the same for the past three years, Census Bureau reported recently. Average income of men has climbed about $1,500 since 1945, or 85%. Average income of women for the same period increased about $200, or 24%.

Electric power output in early June was 9.1% ahead of a year earlier, with a weekly total of 10.95 billion kwh. Highest increase was in the South Central region, at 17.2%, and lowest increase was in Mid-Atlantic region, at 6.4%.



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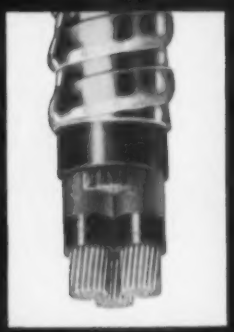

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THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

A Threat to Economic Progress

THERE are two paramount reasons for concern over the serious shortage of scientists and engineers that now confronts the United States:

- The first reason, with which this editorial deals, is that continued expansion of our economy and further increases in our living standards are threatened unless we train more scientists and engineers and use them more effectively.
- The second reason for concern is that we run the risk of falling behind the Soviet Union in the technology so essential to national security. The consequences of losing this race to the Russians are not comforting. (The possibility that this might happen over the next few years was discussed in an earlier editorial in this series.)

The crucial contribution of scientists and engineers to the well-being of the American people has been to find ways of making better use of limited resources, to make equipment more productive, to develop new and better products that enrich our lives, to enable us to live longer and be healthier. They have made this contribution with greater success in the last 15 years than ever before, but it has required progressively more resources and more trained people.

During this 15-year period our annual production of goods and services, in dollars of constant purchasing power, has almost doubled. Since our total population has increased only 25 percent, this has meant a tremendous rise in the economic well-being of the American people as a whole. But in accomplishing this, the number of scientists and engineers has been more than doubled.

Tasks for Research

If the American economy is to continue to grow and if our living standards are to show further improvement, the work of scientists and engineers must be stepped up even more in the years ahead. Unless answers to several pressing problems are found through intensified research efforts, economic progress will become increasingly more difficult.

Productivity per hour of labor must be increased at a faster rate. Improved medical care has greatly increased the number of people who attain retirement age, and sharply higher birth rates since the war will mean larger numbers of children in school and college. Meantime, because of low birth rates during the depression, the number of people reaching working age is not rising nearly so fast. The result is that over the next 20 years our population will increase by about one-third, while the total manhours worked are not expected to increase more than 15 percent. So, simply to maintain the same living standards for a rising population — with no provision for additional improvements — ways must be found to enable each worker to produce for more dependents.

It is primarily to the scientists and engineers that we must look for help in making human labor more productive. This will require enormous increases in our power

resources. We will need to make more effective use of our existing fuel supplies — coal, oil and natural gas. And we will have to devise economically practical means of tapping other energy sources, particularly nuclear power and new rocket fuels.

Also, better ways must be found to use scarce and low-grade raw materials. Thanks to great strides in metallurgy and mining techniques, we are now utilizing sources of copper and iron ore that, for all practical purposes, were not available to us only ten years ago. Similar strides are needed in the mining and processing of bauxite if low-grade domestic ores are to help satisfy a fast-growing market for aluminum. And stubborn technical obstacles in the area of "high temperature" metals—such as nickel, cobalt, columbium, tantalum and titanium — are impeding progress in jet and turbine engines.

These are only a few of the challenging tasks that demand intensified research and engineering activity in the years immediately ahead if the United States is to continue to raise living standards. We need more houses, schools and highways for a rising population, more medical research to reduce further the ravages of illness, more research in chemistry and other sciences to sustain the flow of new and improved products that are so essential an ingredient of our economic progress.

Ceiling on Growth

American industry has indicated that it is ready to meet the challenge and undertake vastly expanded research programs. A recent survey conducted by the McGraw-Hill Department of Economics revealed that total research and development expenditures of American industry were almost $5 billion last year, 29% higher than in 1953. By 1959 business plans to be spending well over $6 billion on research and development. And the total could well prove to be much higher, based on the trend of recent years.

But industry's programs for research and development cannot be carried out unless enough qualified research workers and engineers are available. Ernest R. Breech, chairman of the Ford Motor Company, recently described the supply of engineers as the "ceiling on our future growth." He gave force to his point by announcing: "If 900 qualified engineers were to approach us next week looking for jobs, we would hire every one." The U. S. Bureau of Labor Statistics found in interviews with some 200 large companies at the end of 1954 — a recession year — that at least half were unable to hire enough research scientists and engineers to meet their needs. A third of the companies reported substantial shortages of technical personnel.

The shortage of technically trained people, furthermore, is becoming more acute. The number of engineers and scientists now being graduated is only about enough to cover replacement requirements, while the needs of industry, government and education are mounting every year. According to the best information available — as indicated in the first editorial in this series — these needs are now about twice as great as our current engineering graduating classes and annual production of scientists with Ph. D. degrees.

To perform the research needed to remove roadblocks to our economic progress — and at the same time hold our own in the technology essential to our security as a free nation — we must have an adequate supply of men and women with engineering and scientific training. Instead, we are faced with an acute shortage, now and for several years to come. Reasons for the shortage and proposals for working our way out of the shortage will be discussed in the remaining two editorials in this series.

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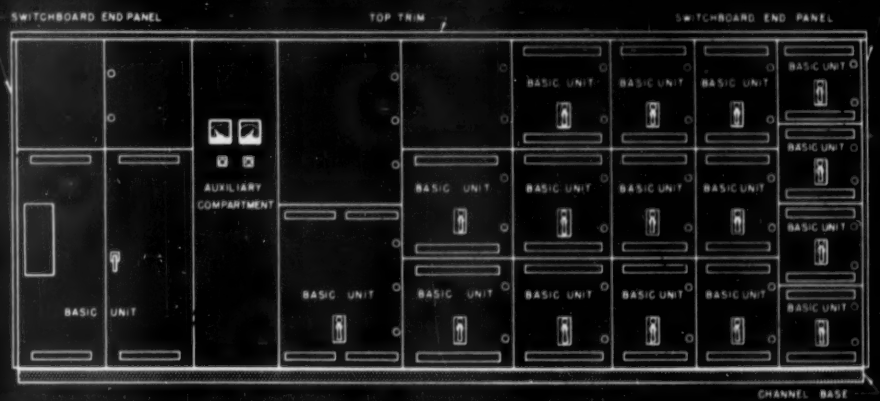

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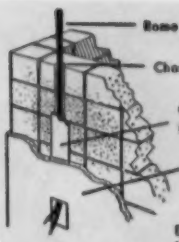
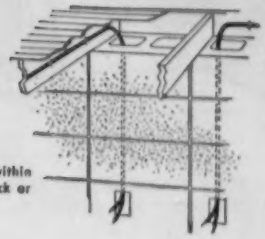


Embedded in plaster, Rome FlexAll makes for neater appearance in rewiring old buildings

Installed in livestock buildings or other locations destructive to conventional nonmetallic sheathed cable, Rome FlexAll is safe, nonrotting and flame resistant.



Rome FlexAll is easy to work within hollow spaces of masonry block or tile walls.

U/L approved multi-purpose cable

Distributor and contractor alike profit by recommending Rome FlexAll, thermoplastic nonmetallic sheathed cable. Low cost and versatile in application, it is *today's* wiring material for industrial, commercial, farm and residential branch circuits.

FlexAll leads to increased sales volume because it is neat appearing, easy to work and *assures safety* where conditions of moisture and corrosion are present. Designed for multi-purpose use, it is equally suitable for underground circuits buried directly in earth, or the interior wiring of wet and corrosive locations.

Specifically, FlexAll is recognized by the National Electrical Code for the following types of installation:

Single Conductor—Underwriters' Approved as Type UF

- For branch or feeder circuits buried directly in earth, when provided with over-current protection.

Multiple Conductor—Underwriters' Approved as Type UF and NMC

- For branch or feeder circuits buried directly in earth, as above.
- For interior wiring, either exposed or concealed, in dry, wet or corrosive locations.
- For installation within hollow spaces of outside or inside masonry block or tile walls.
- For embedding in plaster or shallow chase in masonry, when suitably protected.

Rome FlexAll is part and parcel of today's modernization trend. Developed primarily for the safer wiring of farm buildings, it leads to the vast potential of that market. With its dual approval for direct-in-earth burial, it is ideal for a host of outdoor lighting applications . . . rural, industrial, commercial and residential. In addition, there is a growing demand for it in the wiring of food processing plants, dairies, breweries, packing houses, cold storage and ice plants . . . anywhere that moist and corrosive atmospheres prevail. FlexAll has exceptionally long life exposed to air containing salt, smoke or humidity. Are you getting your share of this sales volume?

Yes, you can build sales volume *with profit*, with Rome FlexAll and here are some of the reasons:

- It permits smaller inventory—one type of wire for a number of applications.
- It works easily—saves on-the-job time.
- It creates customer satisfaction—is neat appearing and pleasant to handle.
- It has long life.
- It is safe and, therefore, a factor in fire prevention, particularly in rural areas.
- It is nationally advertised and approved as a multi-purpose wiring material.

Rome FlexAll is insulated and sheathed with Rome Synthinol, thermoplastic compound. In the two- and three-conductor types the individual conductors are wrapped with glass fibers. Its entire construction, therefore, is inorganic with nothing to rot or deteriorate. Further, FlexAll resists flame, moisture and abrasion.

Single-conductor Rome FlexAll is manufactured in sizes 4 AWG through 14 AWG. Standard color is black. Two- and three-conductor types are manufactured in sizes 10 AWG through 14 AWG. Standard color is pearl gray. Two-conductor sizes are made with and without ground wire.

If you are not already selling and installing Rome FlexAll, write or phone your nearest Rome Cable representative for Bulletin UF-1. It is yours for the asking.

It Costs Less to Buy the Best

ROME CABLE Corporation
ROME · NEW YORK
and
TORRANCE · CALIFORNIA

Full-Color Movie Tells Dramatic Story of Cable

CABLE PATHWAY OF POWER. A 45-minute feature film in sound and color, 16mm. Now available for showings to technical personnel. Write Rome Cable Corporation, Rome, New York, for bookings.

Published in the interest of the Soft Drink Canners Association and the canning industry.

No headaches in these drinks!

Eliminate the hazard of broken bottles in your plant by providing your employees the safety and convenience of canned soft drinks.

Call your soft drink supplier and learn the many advantages of dispensing drinks the modern way—in cans.

QUALITY YOUNGSTOWN SERVICE

Above are illustrated two of the modern cans for soft drinks, now available for in-plant use.

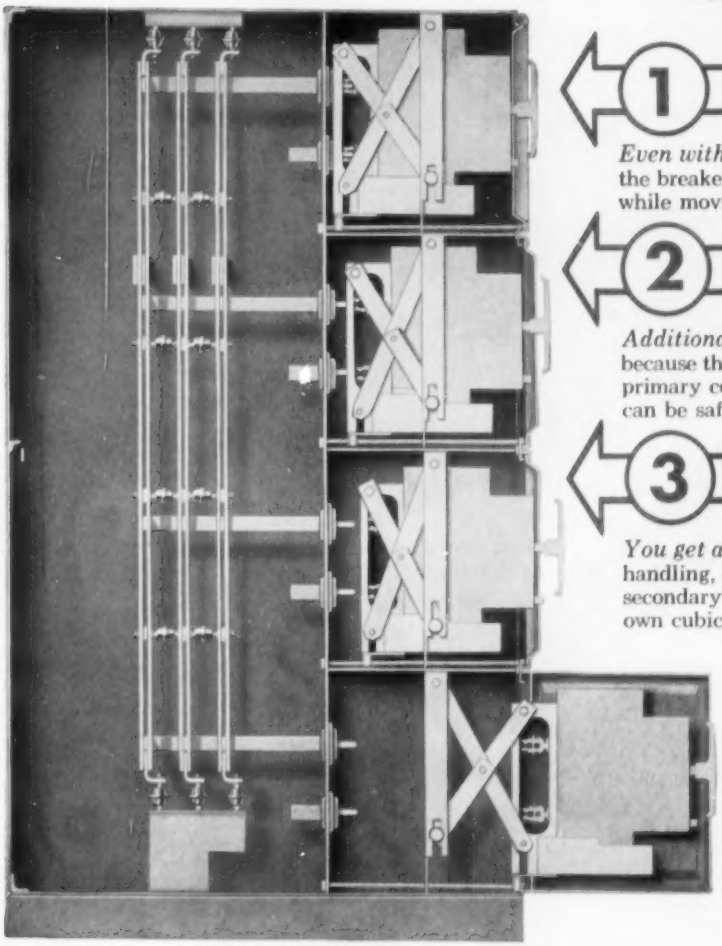
THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices Youngstown, Ohio District Sales Offices in Principal Cities.

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - BLACK PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

Positive Protection for YOUR Personnel

Get the Low Voltage Switchgear that's Fully Enclosed in ALL 3 POSITIONS



1 OPERATING POSITION

Even with the door open, dead-front construction of the breaker means complete safety for your personnel while moving breaker in or out of operating position.

2 TEST POSITION

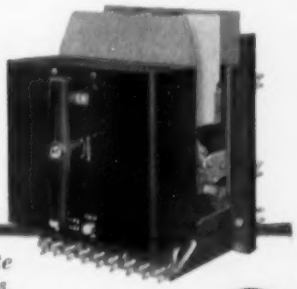
Additional protection for your personnel is assured because the breaker can be moved to test position with primary contacts disconnected, and breaker operation can be safely checked with compartment door closed.

3 DISCONNECTED POSITION

You get added convenience — save storage space and handling, because the breaker, with both primary and secondary contacts disconnected, can be stored in its own cubicle with the door closed.

Inspection also is simplified. In the fully withdrawn position the primary and secondary contacts are clearly visible for inspection without removing the breaker from the cubicle — and it's all done with a convenient, reversible door panel and a rigid, positive-positioning pantograph mechanism.

The breaker provides new flexibility. Long time, short time and instantaneous tripping devices are available. Each is adjustable independently of the other. Selective trip feature available initially or may be added later. Time delay device is sealed, positive displacement type for accuracy. An unusual feature of this new breaker is the faulted phase indicator which tells your operator at a glance on which phase fault occurred. Breaker is dead-front for safety of personnel.



Get more information. Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

A-C ALLIS-CHALMERS

A-5055

ALLIS-CHALMERS

LIVE BETTER ELECTRICALLY

For top value . . . in any type . . . get JENKINS

Gold Seal Tape

FRICTION · RUBBER · PLASTIC

BEST BUY FOR PLANT SUPPLY

All types of **GOLD SEAL TAPE** — Friction, Rubber, Plastic — are packed in 10-roll cartons as well as single rolls.
Every roll cellophane-protected, stays fresh.
Jenkins Bros., Rubber Division, 100 Park Ave., New York 17.

DIAMOND SEAL
Friction and Rubber Tapes
are also made by Jenkins Bros. to ASTM specifications

TRADE JENKINS MARK

Jenkins Bros.

Specify PHELPS DODGE HABIRITE-INSULATED ARMO-LOK CABLE

Phelps Dodge Armo-Lok cable with Habirite (butyl rubber) insulation—a companion to Phelps Dodge Varnished Cambric insulated interlocked armor cable—is more than "just another interlocked armor cable."

Habirite—developed through years of Phelps Dodge experience in the design and manufacture of high voltage cables — is a specially engineered butyl rubber compound. It far surpasses any other type of rubber insulation for dependable service.

Habirite offers these distinct advantages over other rubber insulations:

- Far greater resistance to heat and oxidation with consequent higher temperature rating and lower conductor size and cable cost.
- Far greater resistance to ozone found around high voltage equipment.
- Far greater mechanical toughness.
- Better electrical properties affording a greater safety factor in operation.
- Highest uniformity due to controlled uniformity of raw material.

★ ★ ★

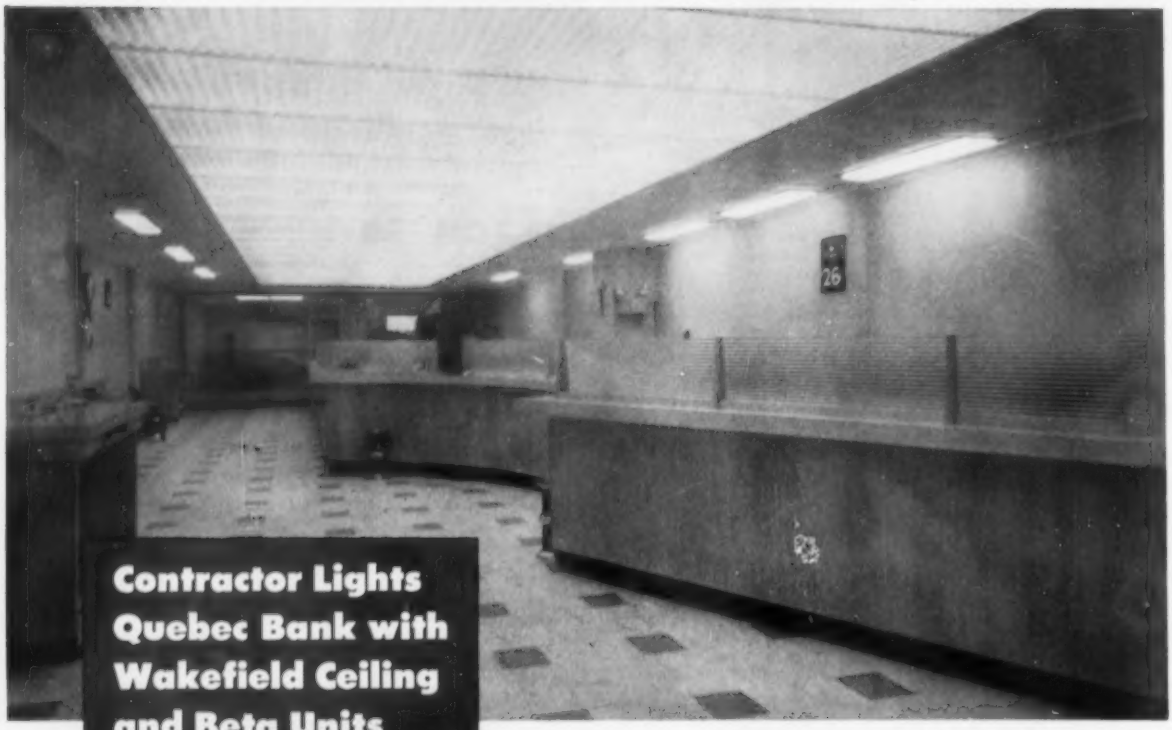
See your Phelps Dodge distributor for information on a complete Armo-Lok system. For catalogue and specification data on Habirite or Varnished Cambric insulated Armo-Lok cable, write: Dept. E-7, Phelps Dodge Copper Products Corporation, 300 Park Avenue, New York 22, N. Y.

PHELPS DODGE COPPER PRODUCTS CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

WAKEFIELD CEILING

Another Installation



Contractor Lights Quebec Bank with Wakefield Ceiling and Beta Units

Caisse Populaire Notre Dame de Lourdes de Verdun, Verdun, Que.

Old store is transformed into modern bank interior with over-all lighting provided by a Wakefield Ceiling and perimeter lighting furnished by Wakefield recessed Beta units.

Electrical contractors are becoming increasingly aware of the adaptability of Wakefield lighting equipment to various lighting situations. Here for example, the general contractor and the electrical contractor put their heads together and transformed an old store into a modern, attractive, functional bank interior, using equipment from the varied Wakefield line to furnish the illumination. You would never know that the old ceiling, now completely hidden, was of wood construction with 12″ x 2″ wood joists running the length of the building, on 16″ spacing, with steel beams running crosswise, cutting up channel runs. The electrical contractor reports that despite these difficulties, the mechanical and electrical features of the Wakefield Ceiling made installation relatively simple.

Over-all lighting: a Wakefield Ceiling of corrugated plastic suspended on fusion strips. Initial footcandles 75.

Supplementary lighting: eight 1′x4′ Beta units with Rigid-Arch plastic diffusers (2 40-W Rapid Start lamps) recessed in metal type acoustical pan perimeter.

Electrical Contractor:
Verdun Armature Works, Verdun, Quebec

General Contractor:
Fernand Asselin, Verdun, Quebec

If you have not already obtained Wakefield Catalog 55 containing essential data on this and other Wakefield lighting equipment, you should write for your copy at once.

THE WAKEFIELD COMPANY
VERMILION, OHIO

WAKEFIELD LIGHTING LIMITED
LONDON, ONTARIO

IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

NEW INSULPRENE

OIL RESISTANT • WATER RESISTANT • IMPACT RESISTANT

Twist-Lock®

Strongest, toughest, most wear-resistant Rubber Connector ever produced.

CAT. NO. **9966**
3 WIRE

20 Amp. 250 Volts (AC or DC)
10 Amp. 600 Volts (AC only)

IT'S RUGGED!

1. A tough fibre disc has been molded into the INSULPRENE ⅛" from the face to insure positive polarity and anchor the blades securely in position, thus preventing accidental pull-out.

2. Blade slots in the disc, accurately die-stamped, prevent incorrect insertion of blades even when extreme pressure is applied.

3. #8 screws with extra large heads simplify wiring and provide a secure connection.

4. Fibre retaining piece anchors terminal plates and seals off wiring area from lint and dust.

5. Powerful Hubbell cord grips eliminate tension from the terminals.

6. Extra rugged terminal plates of ⅛" brass.

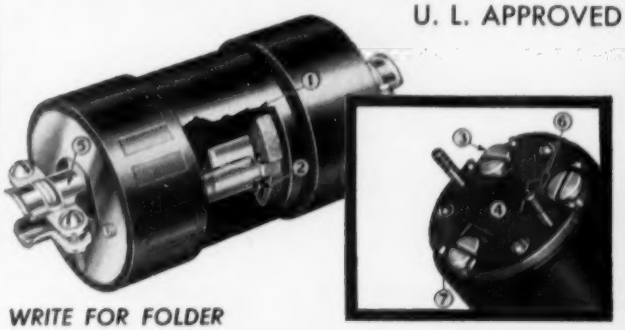
7. Double wire lugs on each terminal plate effectively confine wire strands.

8. Will accommodate same caps used with regular Twist-Lock units.

U. L. APPROVED

This new series of rubber Twist-Lock Connector Bodies is molded from an exceptionally tough neoprene composition prepared especially for Hubbell. Because of its excellent insulating properties and outdoor aging characteristics, this new material has been named Hubbell **Insulprene.** It has a high impact resistance enabling it to stand up under the roughest abuse and, in addition, it resists oil, hot water, live steam, grease, fatty acids.

Insulprene Twist-Lock Units, available in 2-wire, 3-wire and 4-wire sizes, are among the safest, most secure and long-lived Twist-Lock Connectors ever produced. Designed to withstand rough industrial or commercial service, they are ideally suited for welding shops, paint-spray rooms, heat-treating departments, bakeries, laundries, car-wash establishments, drive-in theatres.



WRITE FOR FOLDER

Buy them from your nearest electrical wholesaler

Harvey Hubbell, INC.

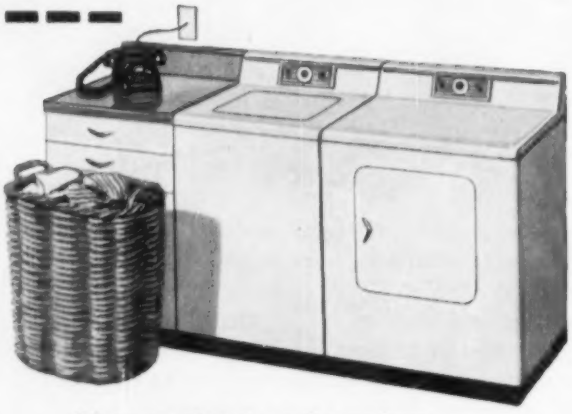
DEPT. C-1 **BRIDGEPORT, CONNECTICUT**

FACTORY WAREHOUSE LOCATIONS ASSURE NATIONWIDE STOCK AVAILABILITY

State and Bostwick Sts. Bridgeport 2, Conn. | 37 South Sangamon St. Chicago 7, Ill. | 103 North Santa Fe Ave. Los Angeles 13, Calif. | 1675 Hudson Ave. San Francisco, Calif. | 1111 Dragon St. Dallas 7, Texas

Built-in for salability

Telephone outlets in the living room, bedroom and kitchen are signs of modern home planning.



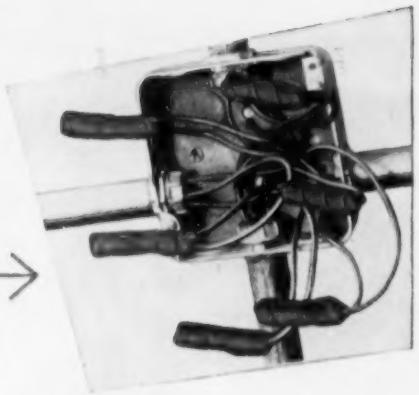
A basement phone is a real convenience, too—saves going up and down steps.

Today's home buyers want convenient telephones around the house—with thoughtfully placed outlets and concealed telephone wiring. Architects with an eye for modern trends put telephone convenience in a class with adequate electrical wiring.

BELL TELEPHONE SYSTEM

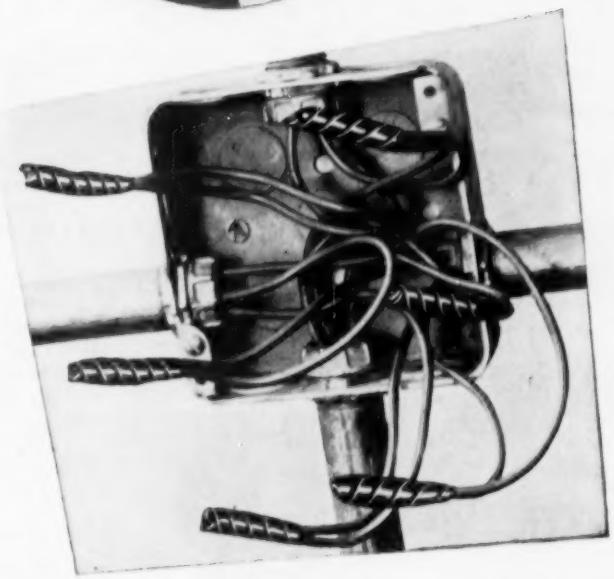
Your nearest Bell Business Office will help you with concealed wiring plans. Just ask for "*Architects and Builders Service.*" For details on home telephone wiring, see Sweet's Light Construction File, 8i/Be. For commercial installations, Sweet's Architectural File, 32a/Be.

Avoid this



use this

for results like this . . .



For neat, sure insulation without bulk, use Porter vinyl electrical tape. One operation does the job. No outer wrapping needed. Dielectric strength stands up to high voltages. Resistant to acids, water, corrosion. Conforms readily to curves. Retains adhesion under toughest service conditions. Ideal for production line and maintenance work. Order from your Quaker distributor.

Porter Vinyl Electrical Tape carries Underwriters' Laboratories Inc. seal

HKP

H. K. PORTER COMPANY, INC.

QUAKER RUBBER DIVISION

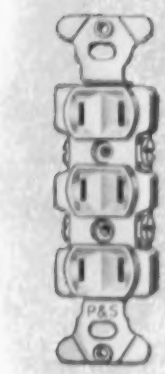
PHILADELPHIA 24, PA. • SAN FRANCISCO 7, CALIFORNIA

H. K. PORTER COMPANY, INC.

SPECIFICATIONS the BEST!

WIRING DEVICES... PASS & SEYMOUR

Hotel Muehlebach and Muehlebach Towers Kansas City, Mo.



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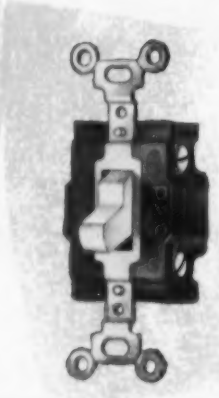


15AC1-I

Improving on an American tradition is no simple task. The men who had the responsibility of planning the 18 story addition to one of America's great hotels – the Muehlebach, faced the task by specifying *only the best.* When it came to wiring devices, they insisted not only on *smart appearance,* but also *dependable operation and long life.* Naturally, they chose Pass & Seymour. Over sixty years of leadership in the wiring device industry have made Pass & Seymour the choice of architects and builders for every type of construction.

In a luxury hotel, every detail is important. Barney L. Allis, president of the Trianon Hotel Co., was able to draw on the experience of people like Architects Neville, Sharp and Simon; Mechanical Engineer William L. Cassell; and Electrical Contractor John D. Hilburn of the Boese-Hilburn Electric Company. To match quality appearance with quality performance, they used Pass & Seymour's switches, outlets and Uniline® wallplates throughout the hotel.

On the left are two of the quality wiring devices specified for the Hotel Muehlebach. For information on these and other devices in the complete quality line, write to Dept. ECM-16.

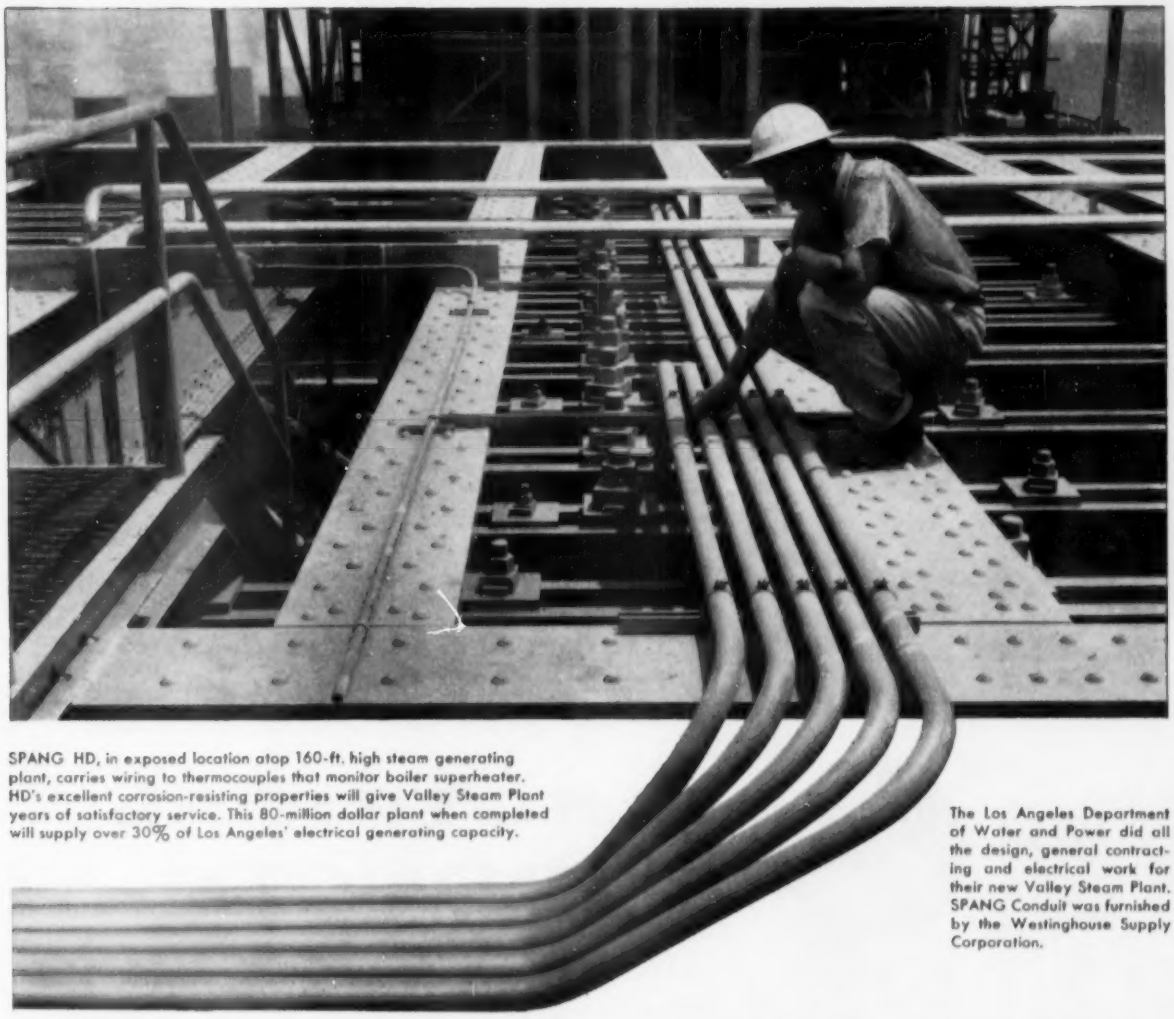
P&S®

PASS & SEYMOUR, INC.

SYRACUSE 9, NEW YORK

71 Murray St., New York 7, N. Y. 1229 W. Washington Blvd., Chicago 7, Ill.

In Canada; Renfrew Elec. & Refrig. Co., Ltd., Renfrew, Ontario



SPANG HD, in exposed location atop 160-ft. high steam generating plant, carries wiring to thermocouples that monitor boiler superheater. HD's excellent corrosion-resisting properties will give Valley Steam Plant years of satisfactory service. This 80-million dollar plant when completed will supply over 30% of Los Angeles' electrical generating capacity.

The Los Angeles Department of Water and Power did all the design, general contracting and electrical work for their new Valley Steam Plant. SPANG Conduit was furnished by the Westinghouse Supply Corporation.

OVER 600,000 FT. OF SPANG HD PROTECTS WIRING AT VALLEY STEAM PLANT

To keep ahead of the rapidly expanding demands for electricity, the Los Angeles Department of Water and Power is completing its new 512,000-kw. Valley Steam Plant in San Fernando Valley. Protecting the wiring in this mammoth installation are over 600,000 ft. of SPANG HD (hot-dipped, heavy-duty) Galvanized Conduit.

SPANG HD will give Valley Steam Plant *top-quality* wiring protection in both exposed and protected locations, because the SPANG HD galvanized and lacquered finish retards the formation of white rust and provides excellent corrosion resistance.

SPANG HD is easy to work with, too! For instance: the *quality-controlled* manufacturing at SPANG produces a uniform product, easy to bend, easy to thread, easy to cut. The *top-quality* galvanized finish will not chip, crack, peel or blister even under the most severe bending strains.

You'll get top performance from SPANG HD on any conduit installation. Try it and prove to yourself why SPANG HD should be your first choice every time. Your nearby SPANG Distributor carries the complete SPANG Conduit line. Let him serve you!

SPANG Conduit uniformity means easier bending, cutting and threading on the job. The top-quality HD finish will not crack, chip, peel or blister during bending.

SPANG CONDUIT

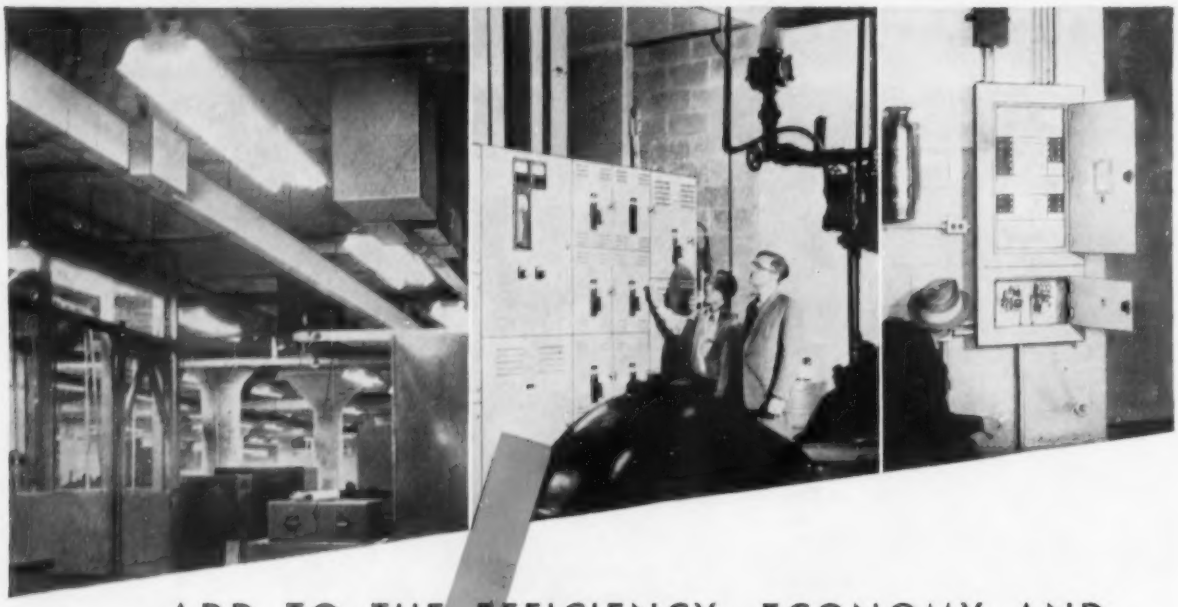
SPANG-CHALFANT

Division of The National Supply Company

GENERAL SALES OFFICE:

TWO GATEWAY CENTER, PITTSBURGH, PA.

District Offices and Sales Representatives in Principal Cities



ADD TO THE EFFICIENCY, ECONOMY AND FLEXIBILITY OF PLANT OPERATIONS

WITH FA **ELECTRICAL PRODUCTS**

For the finest in power and light control and distribution, specify products bearing the trade-mark FA in all your plans for new or modernized industrial buildings.

A pioneer in the electrical industry, FA, over the years, has built an enviable reputation for the manufacture of products of the highest quality — products that have been carefully designed and engineered to provide the maximum in safety, dependability and flexibility — products that will give longer-lasting and trouble free service, which means greater plant operating efficiency and economy.

If you want your client to have power and light control and distribution, geared to the modern tempo, then include FA products in all your future industrial planning.

For complete information on all FA products, contact your nearest FA representative listed in Sweets or send for bulletin.

makers of:
busduct • panelboards • switchboards
service equipment • safety switches
load centers • Quikheter

Frank Adam Electric Co.

Phone JEfferson 3-6550
BOX 357, MAIN P. O. • ST. LOUIS 3, MO.

TYPICAL FA PRODUCTS

FOR USE IN INDUSTRIAL PLANTS

The products shown on this page are illustrative of the wide range of products manufactured by Frank Adam Electric Company for the control and distribution of power and light for industrial buildings.

All products are approved by the Underwriter's Laboratories, Inc., for label service.

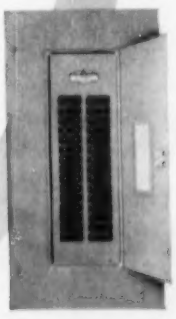
For the finest in power and light control and distribution for industrial and all other buildings, specify products bearing the trade-mark FA.

Powerplugin

Midget Size Powerplugin

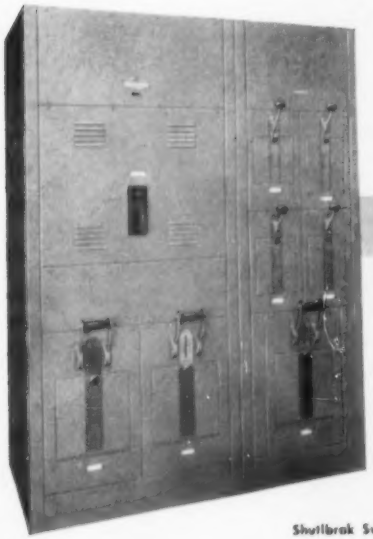
High Efficiency Busduct

SCSD Switch

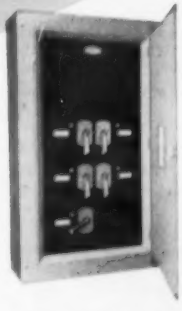


QP Quicklag P Panelboard

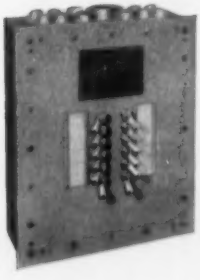
Column type Panelboard



Shutlbrak Switch Board



Shutlbrak Panelboard



Dustite Panelboard

ROCKBESTOS A.V.C.®

(N.E.C. TYPE AVA)

INTERLOCKED ARMORED CABLE

FOR New Buildings
Expanding Existing Circuits
Relocating Old Circuits

Rockbestos A.V.C. Interlocked Armored Cable gives you more current capacity than cable in conduit or other armored cable . . . is easily installed on racks or hangers beneath the ceiling or next to walls . . . can be installed up, down or around walls, beams or posts. It eliminates costly conduit and ducts . . . saves dollars on these materials . . . easier to install . . . cuts installation time . . . permits quick easy repairs.

Write for the new manual which gives application and design data for Rockbestos A.V.C. Interlocked Armored Cable.

ROCKBESTOS PRODUCTS CORPORATION
NEW HAVEN 4, CONNECTICUT

New York • Cleveland • Detroit • Chicago
Pittsburgh • St. Louis • Los Angeles • Seattle
New Orleans • Oakland, California

THIS COMPLETE LINE MEETS EVERY NEED FOR PUSHBUTTONS

STANDARD DUTY

HEAVY DUTY

Name your pushbutton requirement—there's a Square D unit to do the job, exactly. Three complete lines . . . standard duty, heavy duty, and oil-tight heavy duty . . . each providing a wide range of operators, stations, and circuit combinations.

OIL-TIGHT HEAVY DUTY

Available in 1 to 16 unit sizes. 6-9-12-16 unit stations have hinged covers for easier wiring

Write for Pushbutton Bulletins which give complete details. Address Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin.

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!

SQUARE D COMPANY

PLANT PROTECTION *through reliably-maintained light output is assured by Sola Constant Wattage Mercury Vapor Lamp Transformers. Lamps stay lit even when line voltage dips as low as 75v on a 115v line, eliminating jeopardous blackout periods that often exist until lamps are restruck.*

Sola Constant Wattage Transformers Assure Dependable Operation of Outdoor Mercury Vapor Lighting

Sola Mercury Vapor Lamp Transformers offer superior performance, reliability, and reduced system maintenance cost to the expanding market for outdoor mercury vapor lighting. The famous constant wattage principle they employ provides many specific operating advantages. Included are:

- No extinguishing on line voltage dips . . . outages due to line voltage drops are virtually eliminated . . . primary voltage on a 115v line must drop below 75v before lamp extinguishes.
- Regulated lamp wattage and light output . . . energy to lamp is stabilized within $\pm 2\%$ in spite of line voltage swings as great as $\pm 13\%$.
- Open and short circuit protection . . . primary current positively limited under abnormal operating conditions of lamp failure, or external short circuit . . . permits safe use of more lamps per circuit . . . CW circuit eliminates any lamp electrode rectification.
- Extended lamp life . . . regulated voltage, current, and wattage permit continuous stable operation resulting in superior lamp life.

Next time you're concerned with design, specification, or installation of outdoor mercury vapor lighting — shopping centers, parking lots, service stations, playfields, plant area protection—investigate the advantages of Sola Constant Wattage Mercury Vapor Lamp Transformers. Your Sola representative is one of a nationwide organization maintained to provide prompt attention to your requirements.

SOLA *Mercury Vapor Lamp* **TRANSFORMERS**

Write for Bulletin....17G-MV-219

SOLA ELECTRIC CO.
4633 West 16th Street
Chicago 50, Illinois

CONSTANT VOLTAGE TRANSFORMERS for Regulation of Electronic and Electrical Equipment • **LIGHTING TRANSFORMERS** for All Types of Fluorescent and Mercury Vapor Lamps. • **SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414** • *NEW YORK 35: 103 E. 125th St., TRafalgar 6-6464* • *PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988* • *BOSTON: 272 Centre Street, Newton 58, Mass., Bigelow 4-3354* • *CLEVELAND 15: 1836 Euclid Ave., PRospect 1-6400* • *KANSAS CITY 2, MO.: 406 W. 34th St., Jefferson 4382* • *LOS ANGELES 23: 3138 E. Olympic Blvd., ANgelus 9-9431* • *TORONTO 17, ONTARIO: 102 Laird Drive, Mayfair 4554* • *Representatives in Other Principal Cities*

Industry Here Finds Savings in the Stars

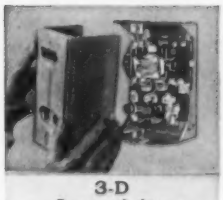
Cutler-Hammer Three-Star Motor Control

Thousands of electric motor users now know the three silver stars on the nameplates of the new Cutler-Hammer Three-Star Motor Control are no meaningless decoration. They stand for three entirely new standards in motor control value and performance . . . for important practical economies no industrial plant can afford to ignore.

Compare Cutler-Hammer Three-Star Control with all other control and *see* the difference. It installs easier . . . so much easier that savings in installation costs often pay for this control. It works better . . . so much better that this control often pays for itself many times over just by the production interruptions it avoids. It lasts longer . . . so much longer that this control *never* requires maintenance care or cost in all normal use. Make your own comparisons and *know*.

Your nearby Cutler-Hammer Authorized Distributor is stocked and ready to serve you. Order from him today. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

CUTLER-HAMMER
MOTOR CONTROL
C-H



3-D Accessibility

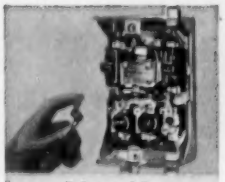
Removing the wrap-around cover bares the entire starter for three-directional accessibility. It is wide open at front and both sides. You can see everything and reach anything. Wiring the starter is so simplified and complete inspection is so easy no detail is ever neglected.

Unit Panel Construction

The entire starter mechanism can be removed from its case by simply loosening three screws. With mechanism out of the way, mounting case, connecting conduit and pulling wires is a cinch. A great time saver. No skinned knuckles. No damaged starter mechanisms.

Full Three-Phase Protection.

Only three overload relays can provide positive three-phase protection to stop needless motor burn-outs and production interruptions. And only Cutler-Hammer offers three overload relays in standard starters to avoid the costs and delays in special construction.



Adjustable Overload Coils

Only the accurate adjustment of overload protection permits motors to work harder without damage. Now more important than ever with newer type small frame motors. Adjustable overload coils here provide an accuracy of 3% instead of 10% to 12% in other makes of control.

Superlife Vertical Contacts

Now the famous Cutler-Hammer dust-safe vertical contacts have been doubly improved. New light-weight design cuts bounce to reduce arcing. Also, arcing is now pressure-quenched. Contact maintenance care and costs are ended for all time in normal control uses.

For Control Panel Designers

New Cutler-Hammer Three-Star Motor Control is star-studded with exclusive new features that provide opportunities for better circuit planning, for compact control panels, for better motor protection and better control performance. Write now on company letterhead for panel design handbook giving complete data.

New Control Components

All parts of the Three-Star Starters in NEMA Sizes 0, 1 and 2, as well as the complete starters on convenient unit panels, are available as components. Electrical interlocks provide additional control circuits as needed.

New Control Relays

Finest of control relays. 10 and 15 Amp. 2-3-4-5-6 poles. All contacts instantly convertible from NO to NC or vice versa. NO or NC status seen at a glance without removing cover. New armored coils color coded for voltage and frequency.

New Oil-Tight HD Pushbuttons

Amazingly compact, one-hole mounting, oil-tight, heavy-duty pushbutton units. Wide choice of button types and colors. Easily added additional contacts permit almost unlimited circuitry. Selector switches and indicating lights to match.

Cuts down "DRAG"... cuts operator fatigue

No more energy wasted on handling heavier, less flexible welding cables. U. S. Royal Gold *Fluted* Welding Cable not only cuts down "drag" and operator fatigue, but also facilitates welding in cramped quarters.

EXCLUSIVE! U. S. Royal Gold's unique yellow jacket of 60% natural rubber provides unbeatable visibility, reduces the hazard of accident which is present with *black* cable. Also, the yellow provides contrasting color to black for conductor identification when two cables are used on welding machines.

LONGER LIFE! The greater flexibility of U. S. Royal Gold means greater dependability at terminal connections, minimum maintenance. Higher visibility reduces danger of accidental damage, adds more life to cable.

COOLER TO HANDLE! The unusual *fluted* jacket provides greater surface area and thereby dissipates heat faster.

SUPERIOR IMPACT RESISTANCE! Proved by tests to be greater than that of conventional constructions.

GREATER MOISTURE RESISTANCE! That's because of the special 60% natural rubber insulation. Added protection is provided by the jacket, also of 60% natural rubber. Get U. S. Royal Gold at electrical supply houses.

Free Folder Gives Facts demonstrating the superiority of U. S. Royal Gold Fluted Welding Cable. Write to us for your copy at Rockefeller Center, New York 20, N. Y.

HIGH VISIBILITY!

US RUBBER

Electrical Wire & Cable Department

United States Rubber

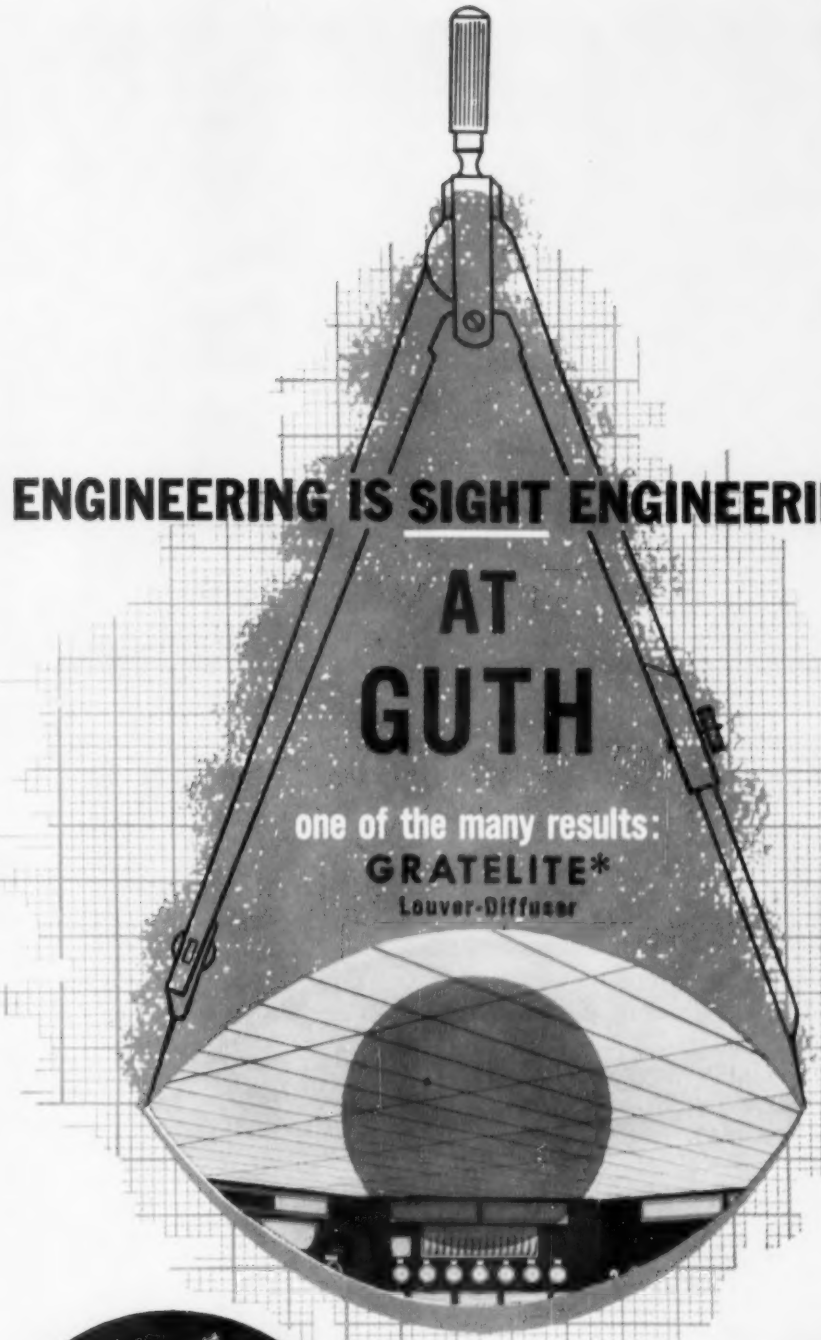
LIGHT ENGINEERING IS SIGHT ENGINEERING

AT GUTH

one of the many results:

GRATELITE*

Louver-Diffuser



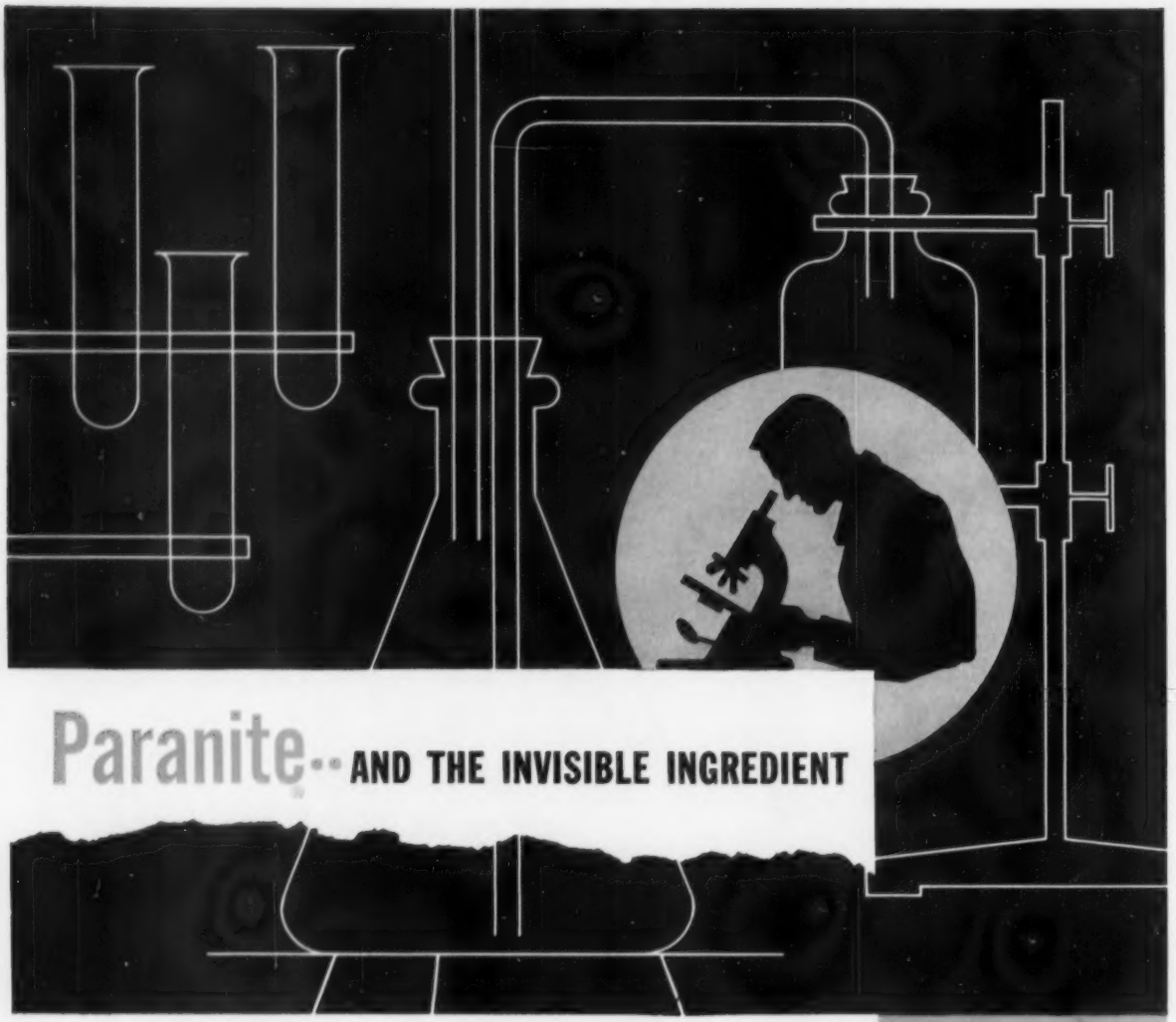
Guth

TRUSTED name in lighting since 1902

THE EDWIN F. GUTH COMPANY

ST. LOUIS 3, MISSOURI

*®U. S. Pat. No. 2,745,001
Canadian Patent Pending



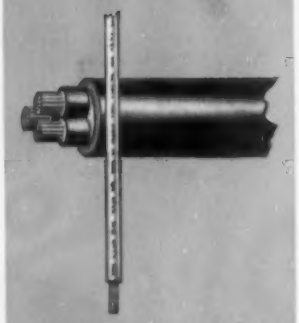
Paranite.. AND THE INVISIBLE INGREDIENT

● Electrical wholesalers and contractors coined a phrase decades ago expressing their confidence in Paranite products: "If It's Paranite, It's Right!" This reference by the trade became so common that in time the company adopted it as the Paranite slogan.

The privilege of enjoying such confidence didn't just happen. It was the direct result of the determination of everyone at Paranite to produce a better product each day than the day before, if humanly possible. This desire to achieve perfection has given Paranite products an "extra" that you cannot see ...or feel...and is truly an *invisible ingredient!*

SQC . . . Statistical Quality Control . . . for years has kept a constant, watchful eye on Paranite products. Scores of tests, graphs and measurements are made and analyzed daily by Paranite engineers seeking ways to give you superior products. This, too, is an important part of the *invisible ingredient.*

So specify Paranite . . . and be assured that every foot of wire and cable will be as nearly perfect as human hands can make it—utilizing modern equipment and cautious testing. This is the *invisible ingredient* working silently at Paranite . . . to your advantage! True today as in the past: "If It's Paranite, It's Right!"



From POWER CABLE to FIXTURE WIRE . . . you'll find Paranite quality high . . . service outstanding!

PARANITE WIRE AND CABLE

DIVISION ESSEX WIRE CORPORATION

FORT WAYNE 6, INDIANA

MANUFACTURING PLANTS: Birmingham, Ala.; Anaheim, Calif.; Jonesboro, Ind.; Marion, Ind.

Warehouses* and Sales Offices

*Atlanta, Georgia; Boston, Massachusetts; *Chicago, Illinois; Cleveland, Ohio; Dallas, Texas; *Detroit, Michigan; Hartford, Connecticut; Indianapolis, Indiana; *Kansas City, Missouri; *Los Angeles, California; *Newark, New Jersey; Omaha, Nebraska; *Portland, Oregon; Upper Darby (Philadelphia), Pennsylvania; Rochester, New York; *Saint Louis, Missouri; *San Francisco, California; Seattle, Washington; Springfield, Illinois.

if you can count to 6* you can win a trip to Paris

*very small catch:

you have to turn the next few pages and look at STAB-LOK'S 6 GOLDEN BENEFITS

1st PRIZE

APRIL IN PARIS!

two heavenly weeks for 2 with all expenses paid!

See Paris in the romantic springtime! Fly quickly to New York, then board a DeLuxe overnight flight to the world-famous City of Light! Stay at the swank Royal Monceau Hotel in the very heart of the city...you'll dine in elegance at world famous restaurants...see the sights of Paris! It's the vacation of a lifetime! And it's all yours free! Of course you can transfer your prize if you wish.

Here's your entry blank

STAB-LOK GOLDEN ANNIVERSARY AD RANKING CONTEST:

(List the best ad first, the next best second, etc.)

This is the way I rank the Stab-lok ads:

1. Wastin' Profits? Get Stab-lok! . . . . . #
2. Chronic Circuit Breaker Problems? Get Stab-lok! . . . . . #
3. Replacement Problems? Not with Stab-lok! . . . . . #
4. Want More Rewiring Profits? Get Stab-lok! . . . . . #
5. Special Enclosure Requirements? Get Stab-lok! . . . . . #
6. Stab-lok's Ready When You Are! . . . . . #

Your name _____

Position _____

Company _____

Company Address _____

City _____ Zone ____ State _____

It's the simplest contest you've ever heard of! Just look at the Stab-lok advertisements on the next few pages...then fill in the entry blank ranking the six ads in your order of preference. If you rank the ads the way our judges did, you'll win yourself a trip to Paris! Miss out on the trip and you still stand to win one of the five Servel Wonderbars or the fifteen Ansco Flash Champion Camera Outfits! And while you're judging the ads...you'll find out just why we're making the world's finest circuit breaker system...the Stab-lok system with the fabulous 6 GOLDEN BENEFITS!

2nd PRIZE

5 SERVEL WONDERBARS!

Silently, it chills drinks and food! Freezes ice cubes! Always ready to serve as a refreshment center, a snack spot, a portable bar! All in a sleek cabinet that's smart in any setting. Just plug it in! The Wonderbar is silent...efficient...the perfect servant when you're entertaining!

3rd PRIZE

FIFTEEN ANSCO FLASH CHAMPION CAMERA OUTFITS!

A quality camera outfit from Ansco! And what a camera! The Flash Champion has a double-element full lens for sharpest pictures and a built-in yellow filter. Regular 616 roll film gives you clear 2-1/16 x 2½ prints. Complete outfit includes: Ansco flash attachment, Eveready carrying case, roll of Ansco Plenachrome film, 6 flash bulbs, a waterproof gadget bag and the camera!

Here, in small print, are the rules. Our lawyer says we've got to print them.

1. Rank the 6 ads according to your preference. Entries must be made on official entry blanks available here and at any electrical distributor where Stab-lok is sold. All entries must be filled out completely. Print or write clearly.

2. Enter as often as you wish. Each entry must be the original work of the contestant and be submitted in his own name.

3. This contest is open to all electrical contractors and their employees residing in the continental United States and Hawaii, except employees of Federal Pacific Electric Company and their advertising agency and their immediate families.

4. To be eligible, entries must be postmarked not later than midnight, October 15, 1956 and received by October 25, 1956.

5. Prizes will be awarded by Federal Pacific Electric Company. In case of tie, winners will be required to suggest a headline for a seventh ad. Judges' decisions final. No entries will be acknowledged or returned. All entries become the property of Federal Pacific Electric Company to be used as they see fit.

6. This contest is subject to all Federal, State and local laws and regulations.

7. All winners will be notified by mail at the conclusion of the contest.

Nothing to buy!
Nothing
to write!

C'mon in...
The contest's fine!
You can't lose and
you may win!

get in on

Stab-lok's

GOLDEN ANNIVERSARY

AD RANKING CONTEST

CELEBRATING FEDERAL PACIFIC'S 50th YEAR

FIRST CLASS
PERMIT NO. 375
Sec. 34.9, P. L. & R.
BROOKLYN, N. Y.

BUSINESS REPLY CARD

No Postage Stamp Necessary If Mailed In The United States

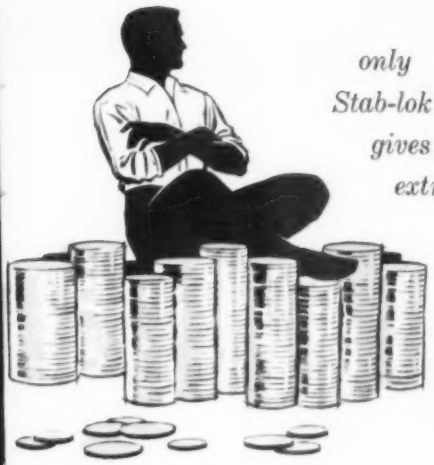
POSTAGE WILL BE PAID BY

FEDERAL PACIFIC ELECTRIC CO.

P. O. BOX 127

BROOKLYN 1, N. Y.

ATTENTION: Contest Dept. A



only
Stab-lok
gives you
extra profits!

wastin' profits?

Are you paying too much for what you're getting? Not if you're installing Stab-lok! No other circuit breaker system gives you so much. For example, you pay for a 16-circuit enclosure and you can install a full 24 circuit breakers. That's made possible by Stab-lok's exclusive Magic "E" slot construction and the ½" NC breaker. Then add to this money saving advantage Stab-lok's time-proven dependability and you've got the finest, most profitable circuit breaker system available today. And of course, you've proven it yourself by installing more Stab-lok than any other circuit breaker system!

Just one of 6 golden benefits found only in Stab-lok

- Only Stab-lok is always modern!
- Only Stab-lok gives you extra profits!
- Only Stab-lok anticipates future requirements!
- Only Stab-lok gives you such a variety of breaker types!
- Only Stab-lok gives you such enclosure flexibility!
- Only Stab-lok is so readily available!

get Stab-lok

Finest Products Engineered

FEDERAL PACIFIC ELECTRIC
COMPANY

50 Paris Street, Newark 1, N. J.

Plants: Newark, N. J. • Long Island City, N. Y. • Cleveland, Ohio • Atlanta, Georgia
St. Louis, Missouri • Dallas, Texas • Scranton, Pennsylvania • Los Angeles, California • San Francisco, California • Santa Clara, California • Emeryville, California

GOLDEN BENEFIT 1

FPE
FEDERAL PACIFIC ELECTRIC

GOLDEN BENEFIT 2

FPE
FEDERAL PACIFIC ELECTRIC

only Stab-lok gives you such a variety of breaker types!

chronic circuit breaker problems?

get Stab-lok

What's your circuit breaker problem? Ambient temperature? Multi-pole safety? Limited space? Special code requirements? Stab-lok circuit breakers have the answer to all of these! To deal with temperature variants, Stab-lok breakers are equipped with the exclusive "Hi-Lo" Ambient Temperature Compensator that eliminates premature tripping due to heat and delayed tripping due to cold. Install Stab-lok anywhere...you'll know your conductors have positive protection!

And Stab-lok provides multi-pole safety without annoying, hit-or-miss methods...eliminates handle ties and extensions. A precision-built, common-trip 2-pole breaker does the trick.

Again it's Stab-lok's "2-for-1" feature...this time it's space. Smaller enclosures can be used because the ½" NC Breaker takes half the space of normal 1" breakers—doubling the number of circuit breakers that can be installed.

And Stab-lok's 2-pole, Switching Neutral breaker meets special code requirements for gas station islands. In addition, this breaker saves you time and money by fitting into all Stab-lok enclosures. No wonder more electrical contractors install Stab-lok!

Just one of 6 golden benefits found only in Stab-lok

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replacement problems?

It's been six golden years since Federal Pacific first introduced Stab-lok...yet a 1950 Stab-lok breaker can be used with a new 1956 enclosure...and even more important, a Stab-lok circuit breaker produced today can be used with a 6-year-old enclosure!

The last six years have seen Stab-lok add the ½" NC breaker, ambient compensation, sequence bussing, split bus panels and many other new features. And yet not one Stab-lok breaker or enclosure has been obsoleted! Only Stab-lok is designed for your future! Only Stab-lok never grows old...never fails to give you the newest and finest in circuit breaker protection!

Just one of 6 golden benefits found only in Stab-lok

- Only Stab-lok is always modern!
- Only Stab-lok gives you extra profits!
- Only Stab-lok anticipates future requirements!
- Only Stab-lok gives you such a variety of breaker types!
- Only Stab-lok gives you such enclosure flexibility!
- Only Stab-lok is so readily available!

not with Stab-lok

GOLDEN BENEFIT 3

FPE
FEDERAL PACIFIC ELECTRIC

Finest Products Engineered

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COMPANY

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St. Louis, Missouri • Dallas, Texas • Scranton, Pennsylvania • Los Angeles, California • San Francisco, California • Santa Clara, California • Emeryville, California

GOLDEN BENEFIT 4

FPE
FEDERAL PACIFIC ELECTRIC

want more rewiring profits?

get Stab-lok

A Stab-lok enclosure can be converted today to half again as many circuits simply by replacing a 1" Stab-lok circuit breaker with two ½" breakers. You just pull out a one-inch breaker!...stab in two ½" NC Stab-loks. You've just added protection for another circuit! The Magic "E" bus bar slot accommodates two 15 or 20 ampere circuit breakers where only one existed before. That's Stab-lok's fabulous "2-for-1" story that tells you how to anticipate tomorrow's need for extra circuits. No longer do you have to add a new enclosure for an extra circuit or two...you save time...you save materials...you save money...you increase your rewiring profits when you plan ahead with Stab-lok.

Just one of 6 golden benefits found only in Stab-lok

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- Only Stab-lok gives you such enclosure flexibility!
- Only Stab-lok is so readily available!

Finest Products Engineered

FEDERAL PACIFIC ELECTRIC

COMPANY

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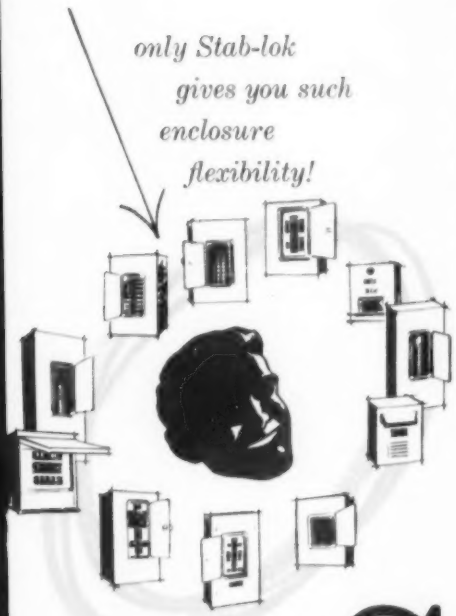
special enclosure requirements?



Think you've got a special enclosure problem? One look at the Stab-lok catalogue may convince you that your "special" is a Stab-lok "standard". Stab-lok's complete line of enclosures is a direct result of the attention Federal Pacific engineers give your installation problems. This policy constantly pays off in benefits to you! For example, combination flush-surface enclosures halve your inventory problem! Fastest neutral wiring is made possible by Stab-lok's step-type neutral construction. A complete line of raintight enclosures...screw or spider washer adjustment of breakers to plaster level in seconds! More reasons why Stab-lok is your favorite circuit breaker system!

Just one of 6 golden benefits found only in Stab-lok

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- Only Stab-lok gives you extra profits!
- Only Stab-lok anticipates future requirements!
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- Only Stab-lok is so readily available!

get Stab-lok

GOLDEN BENEFIT 5

FPE
FEDERAL PACIFIC ELECTRIC

Finest Products Engineered

FEDERAL PACIFIC ELECTRIC

COMPANY

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GOLDEN BENEFIT 6

FPE
FEDERAL PACIFIC ELECTRIC

only Stab-lok is so readily available!

Stab-lok's ready when you are!

Because you have installed more Stab-lok...made it more universally accepted than any other circuit breaker system, it's practically a sure bet that a complete stock is no farther away than your nearest electrical distributor. He's ready with a full inventory of Stab-lok breakers and standard enclosures! And to assure your distributor of a constant flow of Stab-lok, Federal Pacific backs him with a nation-wide string of 27 warehouses and the largest, most modern plant in the world devoted to the production of circuit breakers and enclosures! This easy accessibility...the proven fact that Stab-lok's ready when you are...is yet another reason Stab-lok is the nation's favorite circuit breaker system!

Just one of 6 golden benefits found only in Stab-lok

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- Only Stab-lok gives you extra profits!
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Send for Your Complimentary Copy of this 1956 Edition RLM Specifications Book

NOW MORE USEFUL THAN EVER!

New illumination data and complete up-to-dating of specifications for 36 different RLM industrial lighting units, make this new RLM Book more useful than ever to buyers, sellers and specifiers of industrial lighting equipment. An important change concerns the use—for the first time in RLM Specifications—of the Zonal Method of computing Coefficients of Utilization and illumination on room surfaces. The tables printed in this new edition are based on this method. You'll also find helpful light distribution curves on both incandescent and fluorescent equipment, including the new Semi-Direct fluorescent units, which direct 20% to 30% of the light upward. In addition, there are important changes in the RLM Standard Specifications covering materials, construction and photometric performance.

If your work is at all concerned with industrial lighting equipment, make sure you have this latest edition RLM Specifications Book—you'll recognize it by its green cover with the big red-and-black RLM Label. For your complimentary copy, write to the Institute, or use the coupon.

RLM STANDARDS INSTITUTE
INCORPORATED
The letters RLM stand for Reflector and Lighting Equipment Manufacturers

R-1247

RLM Standards Institute, Suite 819
326 W. Madison St., Chicago 6, Ill.

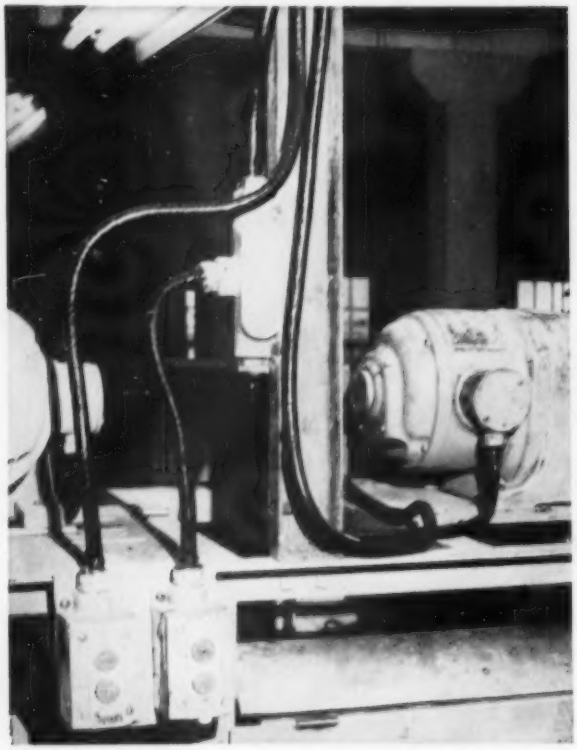
Please send me a copy of the new 1956 RLM Book. I understand there is no cost or obligation.

Name and title _____

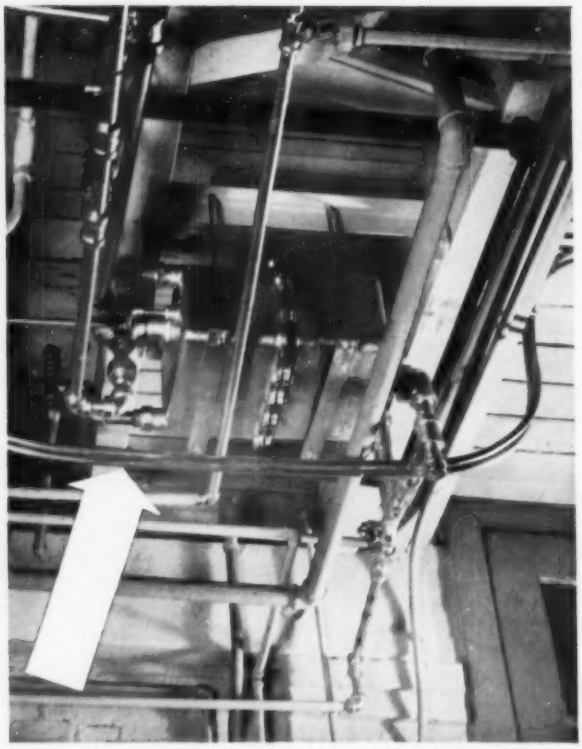
Company _____

Address _____

City _____ Zone _____ State _____



Simple terminations—aluminum-sheathed cables are as simply terminated as conventional rubber-insulated control cables. For leads to motors and control apparatus, an aluminum sheath also provides a neat, space-saving installation. This photo shows optional Okosheath Protective Covering applied over aluminum sheath to combat an extremely corrosive atmosphere in this installation.



Easy installation—aluminum-sheathed cable is inherently rigid, yet see how easily it can be installed around pipes, heat exchangers, and other obstructions. Conduit is eliminated. Regular conduit clamps give all the support necessary for overhead installations. Note that aluminum sheath is seamless, providing a permanent moisture-proof barrier.

new aluminum-sheathed cables eliminate conduit

Many advantages are obtained from the addition of a *seamless* aluminum sheath over standard cable constructions. Virtually any Okonite cable —including rubber, plastic, varnished cambric and paper-insulated constructions—can now be obtained with an Okonite aluminum sheath.

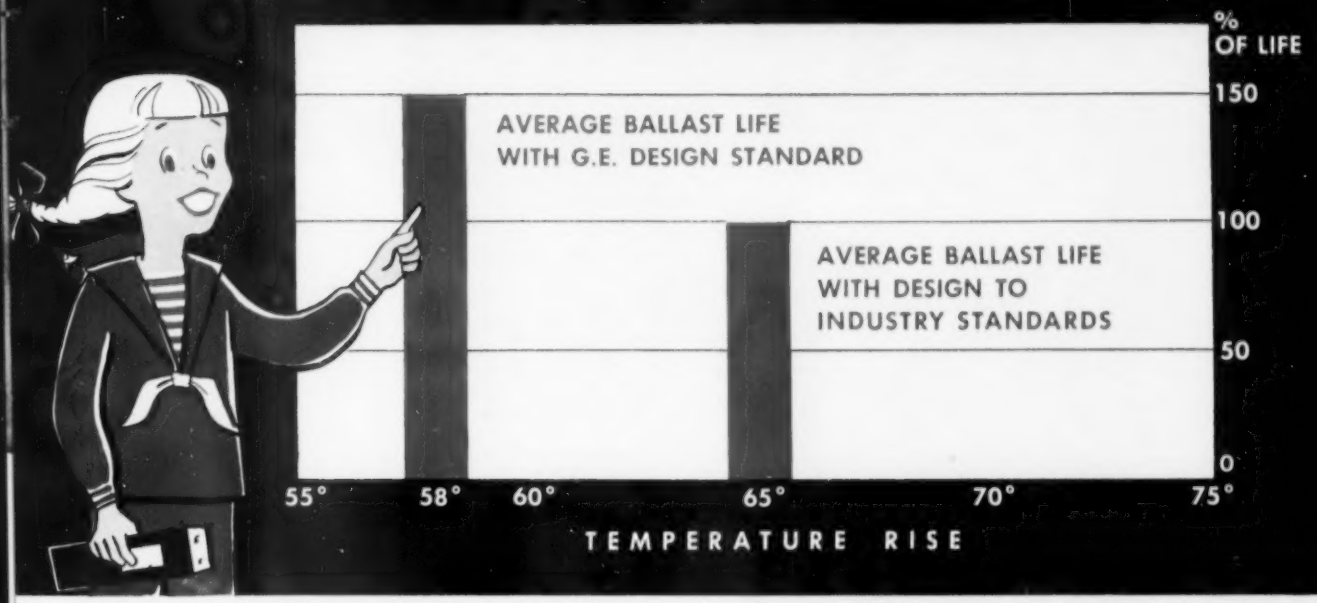
A list of the advantages resulting from this new technique is in the next column. For further information, write to The Okonite Company, Passaic, N. J.

- **no conduit—cuts installation time and costs**
- **eliminates pulling problems and possibility of damage to conductors**
- **high tensile strength and rigidity, yet easily bent with standard tools**
- **impervious barrier to liquids and vapors**
- **mechanically strong**
- **excellent flame resistance**
- **simple terminations**
- **small diameter, light weight**

3502

OKONITE insulated cables

G.E. gives you 50% more ballast life by designing 10% cooler than industry standards



BECAUSE G-E BALLASTS ARE engineered to operate 10% cooler than industry standards, they offer 50% longer life in your fluorescent installation. With this chart, Flora shows you the extra ballast life you get when you specify General Electric's cooler operating ballasts.

Flora* shows you why . . .

General Electric Ballasts Last 50% Longer, Help You Save Lighting Dollars

Every G-E ballast is designed to operate 10% cooler than industry standards; the chart above shows that this means 50% longer ballast life! To you, this means longer life for your fluorescent installations and a real saving in lighting dollars.

By carefully filling each ballast with a special heat-conducting compound, and by using larger wire size in the coil windings than would be required simply to meet industry standards, G.E. builds ballasts that operate cooler! Cooler operating temperatures combined with the use of unusually strong insulating materials results in years of added ballast life.

These special G-E techniques contribute toward lower operating temperatures, resulting in 50% longer ballast life.

Next time you specify equipment for a fluorescent lighting installation, make sure you get the best . . . specify General Electric longer-life ballasts.

A G-E ballast tag or sticker on your fixture is proof that it's equipped with a superior ballast; G-E ballasts in your installation mean better, more efficient lighting, more economical operation. For further information on G-E ballasts, write Section 401-10, General Electric Company, Schenectady 5, New York.

*Miss Fluorescent Ballast, G.E.'s Ballast Mascot

Copyright 1955, General Electric Company

G-E BALLASTS ARE constantly spot-checked for normal or abnormal temperature rise in this special lab. Close control of temperature rise helps assure 50% longer G-E ballast life.

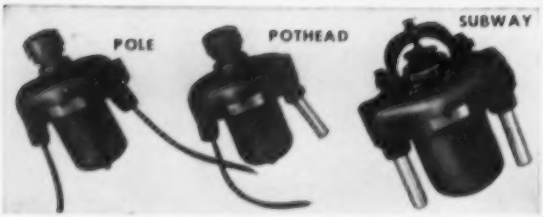
Five more reasons why

GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

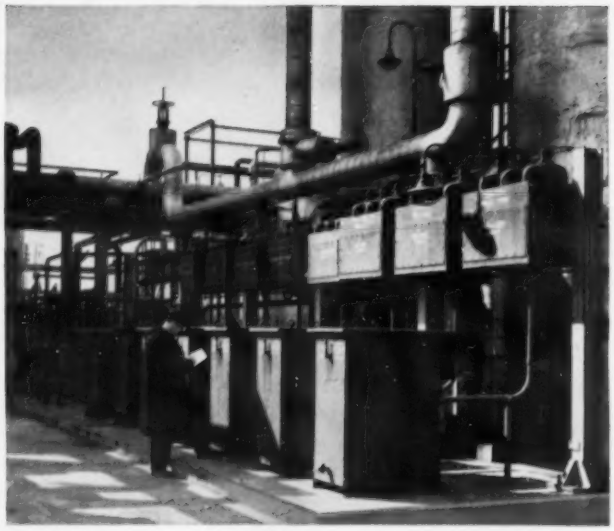
- **EXCLUSIVE SOUND RATING SYSTEM**
- **SUPERIOR QUALITY CONTROL**
- **PRECISE LAMP-MATCHED DESIGN**
- **PROVED PRODUCT LEADERSHIP**
- **COMPLETE CUSTOMER SERVICES**

Progress Is Our Most Important Product

GENERAL ELECTRIC



COMPLETE LINE of G-E oil-filled cutouts includes pole, pothead and subway types and metal-enclosed assemblies.



INDUSTRIALS, such as this oil refinery, use these three-phase metal-enclosed G-E oil-filled cutout assemblies to protect equipment.

UTILITIES with underground systems use G-E oil-filled subway-type cutouts for single phase or three phase, gang-operated, fusing or switching. Expansion chambers are required to secure full interrupting rating.

For best in low-cost switching...industrials, electric utilities choose G-E oil-filled cutouts

Indoors or outdoors, they permit substantial savings on first cost and fuse replacement—combine high interrupting capacity, safer operation and long life

For utility, industrial, commercial and institutional applications that combine overcurrent protection and load-break switching, more and more companies are choosing General Electric oil filled cutouts.

HERE'S WHY: Low-cost G-E oil-filled cutouts provide high interrupting capacity . . . up to 11,000 rms amperes. They provide for maximum safety of personnel . . . all arcing occurs under oil and all flame, noise and electrically live parts are confined within a metal housing. And G-E oil-filled cutouts offer long service life since interrupting ratings are based on test conditions far more severe than those normally encountered in operation.

IDEAL INDOORS OR OUTDOORS G-E oil-filled cutouts are quiet in operation, and they may be wall or direct-to-equipment mounted. Single- or three-phase metal-enclosed assemblies provide for all wiring and electrical connections to be completely enclosed in a grounded steel cabinet. Entrances can be provided for connection to outgoing cables.

Other G-E oil-filled cutout features include:

- Simple fusing, even on gang-operated assemblies. Preformed fuse links easily slip into place.
- Silver-plated self-aligning contacts of heavy forged copper with special arcing tips . . . minimize wear.
- Leads brought into cutout housing above oil level—no gasketed joints under oil pressure.
- Pole and pothead types do not require expansion chamber for full interrupting capacity.

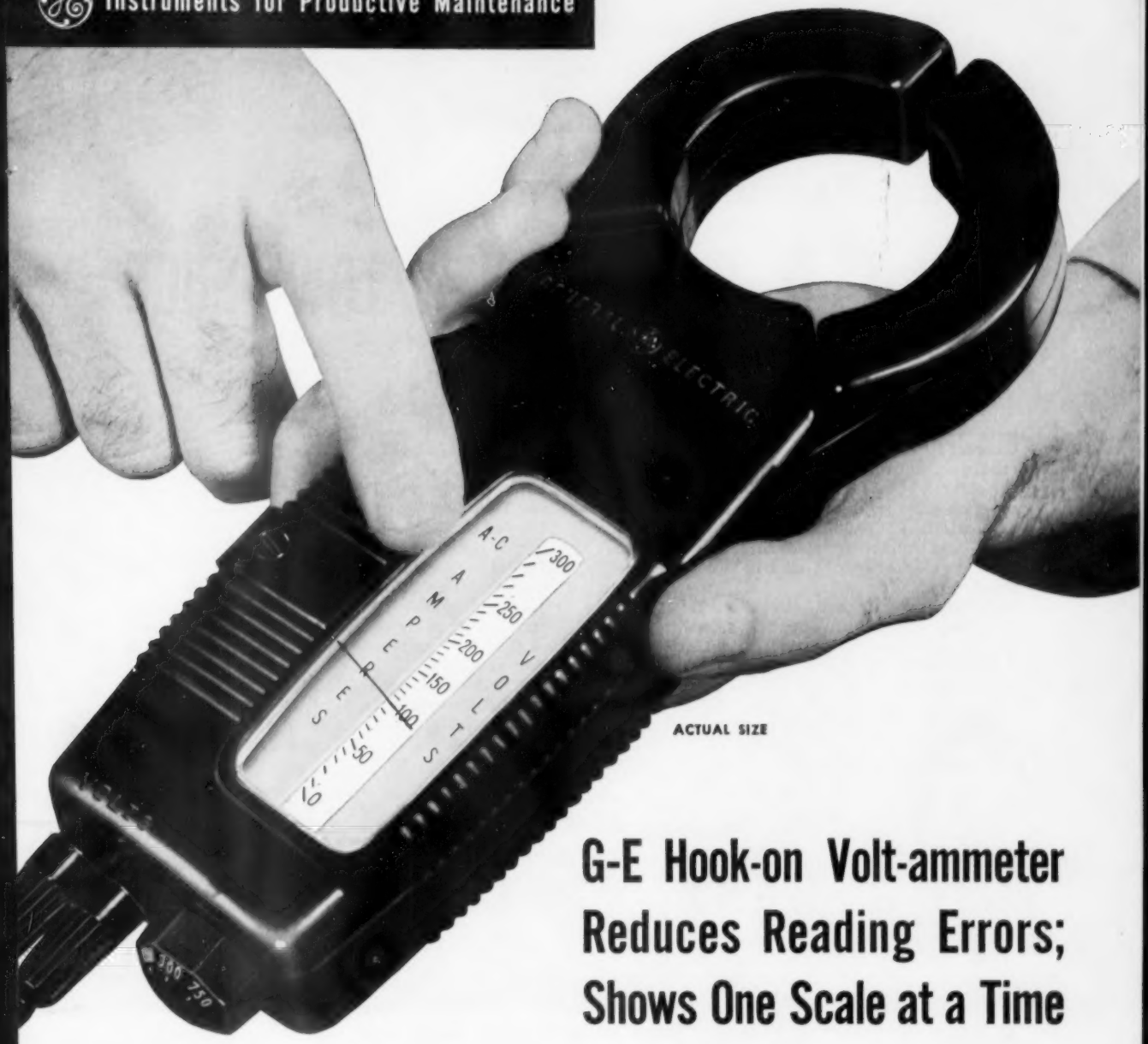
If you have an application that requires overcurrent protection *plus* load-break switching, it will pay you to investigate G-E oil-filled cutouts. Available for 2400-, 4330- and 7200-volt circuits, they can mean substantial savings in initial costs and fuse replacements.

For complete information, contact your nearest G-E Apparatus Sales Representative, or write for bulletin GEC-863, General Electric Company, Schenectady 5, N. Y. 433-12

Progress Is Our Most Important Product

GENERAL ELECTRIC

Instruments for Productive Maintenance



ACTUAL SIZE

G-E Hook-on Volt-ammeter Reduces Reading Errors; Shows One Scale at a Time

GENERAL ELECTRIC'S hook-on volt-ammeter shows only one scale at a time. You simply select the desired range and only the corresponding scale is visible. This eliminates the possibility of reading the wrong scale, as can be done with multiple scale face instruments. The range and scale of this G-E instrument are changed simultaneously by turning the finger-tip control knob. The two models of the instrument are designated Types AK-4 and AK-5, and both have current scales marked in black and voltage scales marked in red.

USED BY contractors, electricians, engineers, maintenance and servicemen, the G-E hook-on is ideal for balancing circuits and tracing faults and grounds without shutting down equipment.

WIDE RANGES are available in both models of the G-E volt-ammeter. Ranges of the AK-4 model are 0-10/30/-100/300/800 amperes and 0-150/300/750 volts. The AK-5 ranges are 0-5/20/80/350 amperes and 0-150/-300/750 volts. The wider range AK-4 model has a pointer-stop to check surge readings.

FOR FURTHER INFORMATION, write section 582-10, General Electric Co., Schenectady 5, New York and ask for bulletin GEA-6292, or contact your nearest G-E Apparatus Sales Office.

Progress Is Our Most Important Product

GENERAL ELECTRIC

THE GENERAL ELECTRIC TSA-40

NEW TIME SWITCH—NEW LOW PRICE

Replacing Type T-27

TSA-40, an entirely new heavy-duty general purpose time switch, has been designed by General Electric to meet your demands for more reliable on-off operation at a lower price.

MANY NEW FEATURES make the TSA-40 a superior time switch for all heavy-duty, on-off applications. Exclusive contact shearing action gives you reliability and long life; new case, latch and cover gasket give complete weather-proofing; smaller size and more wiring space cut installation and maintenance costs; and extended operating temperature limits provide dependable service under a wide range of ambient conditions.

VERSATILE IN APPLICATION, the TSA-40 offers precise and reliable control of all types of street, sign, store window and floor lighting; capacitor switching; heating, air conditioning, and refrigeration; irrigation and pump control; and many other industrial and central station uses. The TSA-40 is fully suitable for both indoor and outdoor applications.

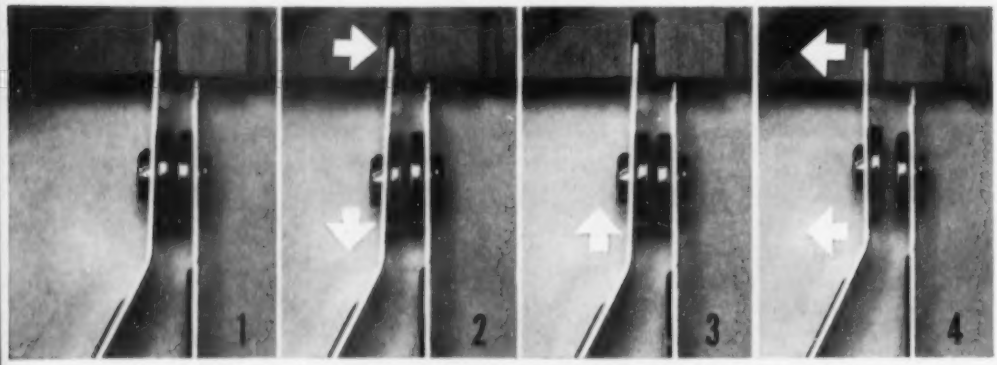
YOU GET EXTRA VERSATILITY when you order a TSA-40 with either or both of these optional features. The *omitting device* permits the TSA-40 to omit its operation on any day or days of the week. It can be added to a standard switch that is already installed. The *astronomic dial* is a special time dial which follows the changing schedule of sunset and sunrise in a particular locality. You save on cost of servicing because the need for regulating the time switch as the days grow longer or shorter is eliminated.

FOR PRICES AND FURTHER INFORMATION, call your nearest General Electric Apparatus Sales Office or write for Bulletin GEA-6468 to Section 584-4, General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

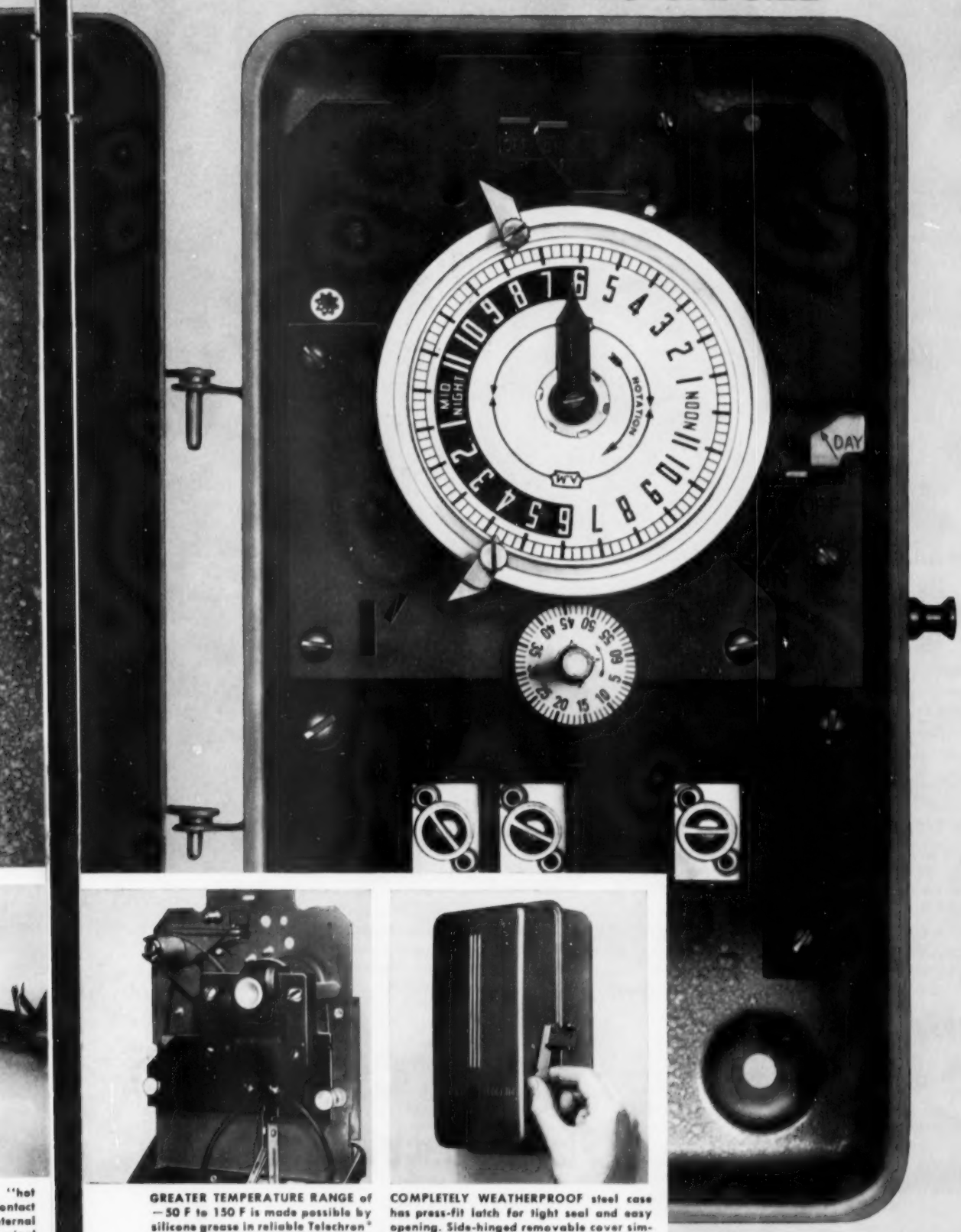
EXCLUSIVE CONTACT SHEARING ACTION GIVES GREATER RELIABILITY



WELDS ARE BROKEN, CONTACTS KEPT CLEAN BY THIS SHEARING ACTION: (1) Contacts, shown here in closed position, are actuated by slotted bar at top of these actual photographs. At start of opening action (2), bar moves to right forcing left contact to move down with shearing action. As bar completes motion to right (3) contacts are released and spring blades cause second shearing action just before contacts snap open (4). Bar and contact blades are now ready for next "on" operation.

NO WIRING BURNOUTS or "hot spots" because one-piece contact and terminal eliminate all internal wiring to contacts. Unit terminal block makes replacement easy.

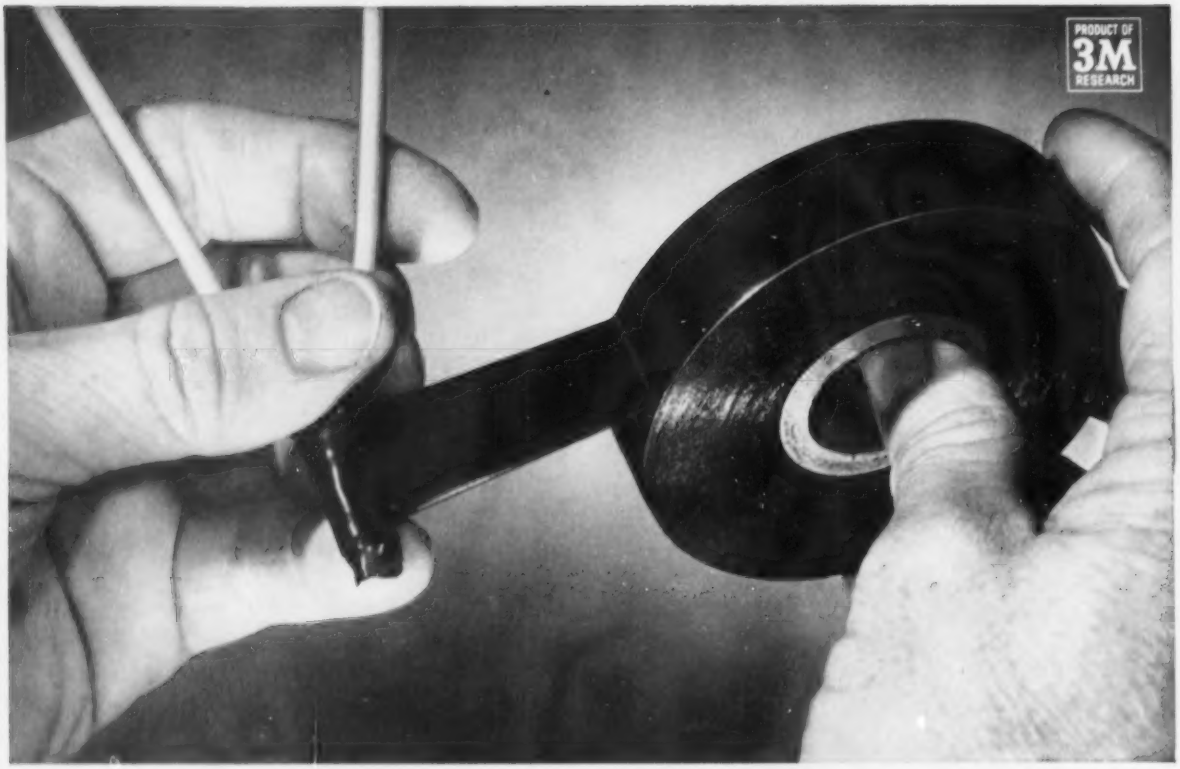
ACTUAL SIZE



GREATER TEMPERATURE RANGE of —50 F to 150 F is made possible by silicone grease in reliable Telechron* motor. Direct drive of switching mechanism assures positive action.

COMPLETELY WEATHERPROOF steel case has press-fit latch for tight seal and easy opening. Side-hinged removable cover simplifies installation and maintenance.

*Reg. trademark General Electric Co.



One-tape splicing cuts insulating costs in half!

Figures prove it! "SCOTCH" 33 Plastic Electrical Tape actually cuts your insulating costs in half!

Look at the facts. You need only *one* tape with "SCOTCH" 33. That means you get twice as many splices in the same amount of time. Contractors have proved *that!*

And what splices you get! Never bulky and awkward to work with in tight places such as junction boxes and condulets. "SCOTCH" 33 is more resistant to water, sunlight, oil, acids, alkalies, alcohols and weathering.

"SCOTCH" 33 gives you splices that *last.* And "SCOTCH" 33 gives you electrical and physical protection in a minimum amount of space (9,500 volt dielectric strength – yet only 7 mils thick).

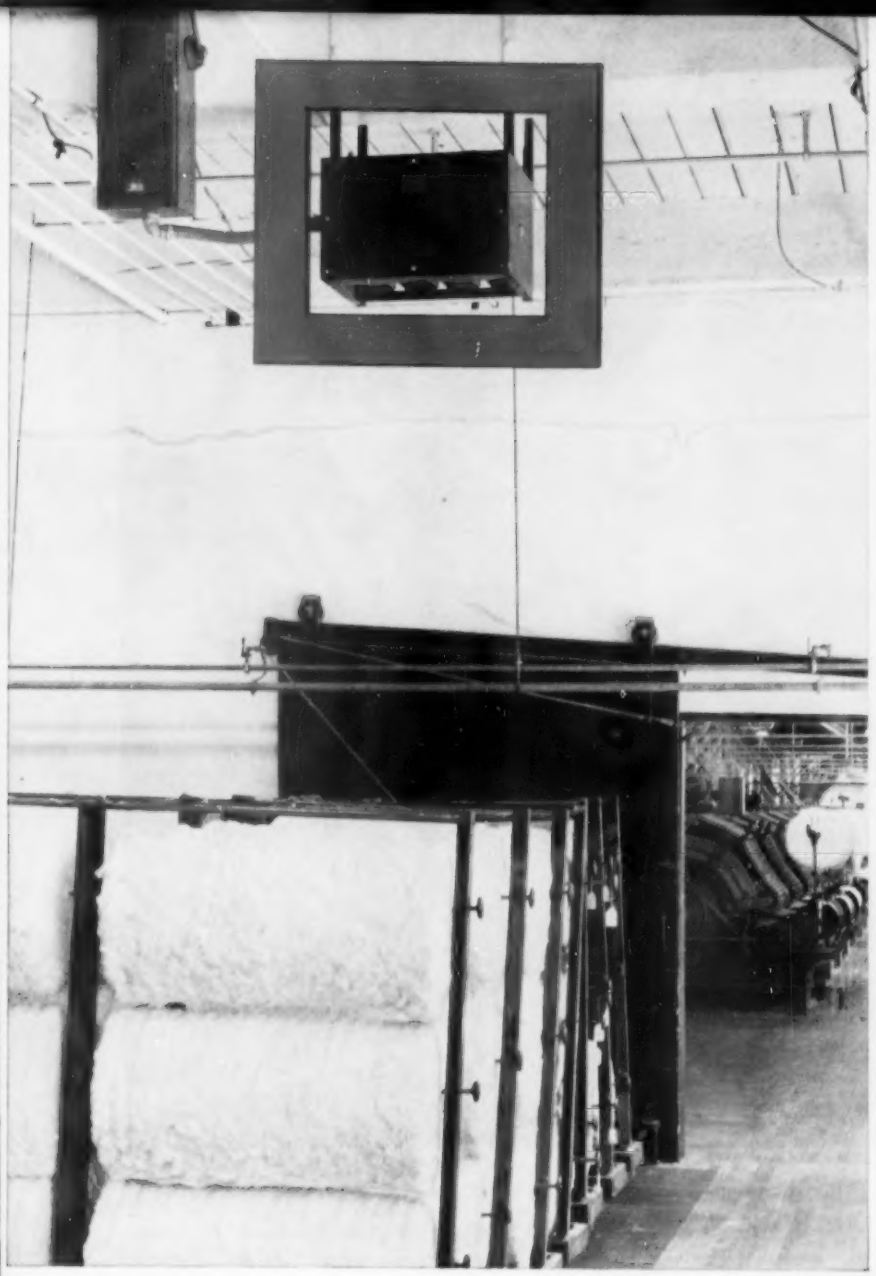
Try "SCOTCH" 33 on your next job. Pocket the difference – with better splices! Learn how you can save even more: new brochure for contractors gives the complete story. Write on your letterhead to 3M Co., Dept. CB-76.

REG. U.S. PAT. OFF.

SCOTCH 33
BRAND
Plastic Electrical Tape

The term "SCOTCH" is a registered trademark of Minnesota Mining and Manufacturing Company, St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

3M COMPANY



LIVE BETTER ELECTRICALLY

How Pepperell saves $15,000 a year with capacitors

"Reduced line losses, increased system capacity, improved voltage conditions and an estimated $15,000 a year savings in our electric power costs are the benefits we've gotten from installing General Electric industrial capacitors," says Mr. Comer Turley, Mechanical Superintendent at the Pepperell Manufacturing Company of Lindale, Georgia.

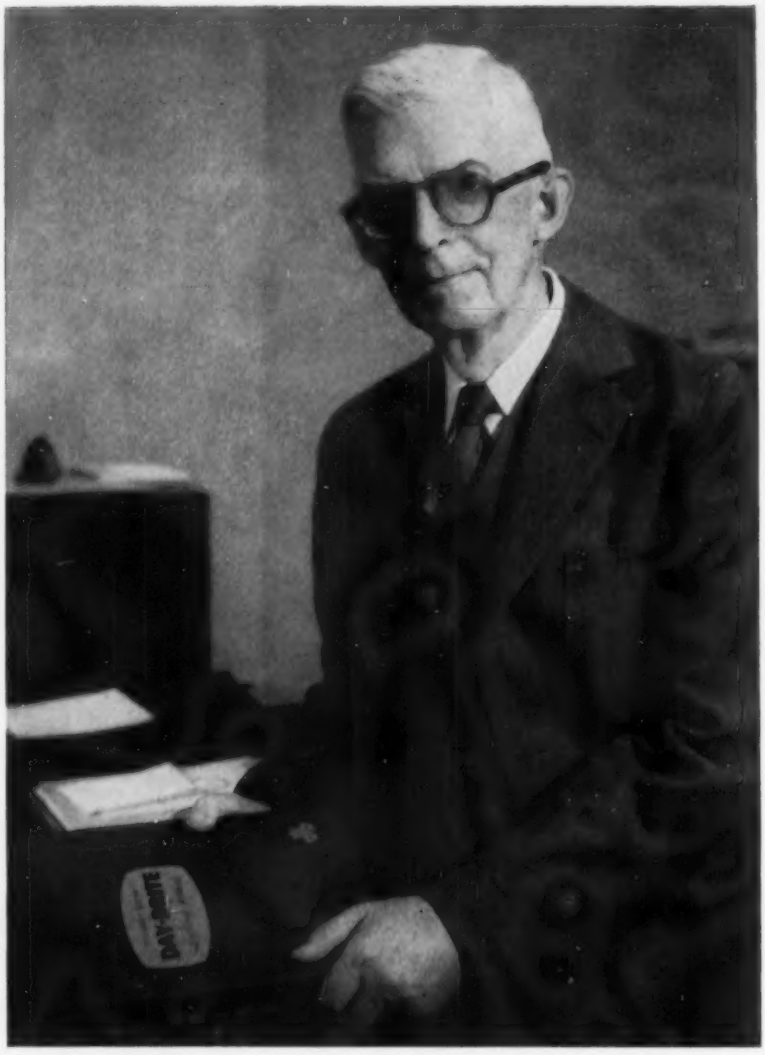
Like most manufacturing plants, Pepperell, maker of denim goods, has a power factor clause in its electric utility contract. This means that the higher its power factor, the lower its power costs. Since the firm started with a power factor of 74% and is now running at approximately 98% power factor, dollar savings, from power-cost cuts alone, amounted to $4481 for the first four months of this year.

Total estimated savings for a year will be easily $15,000. This means that Pepperell will pay off its capacitor investment with dollars saved from its power costs in about two years—and then continue its savings as sheer profit for some years to come. **Can you afford to overlook savings like this in your plant?** If you use induction motors, check your power factor—or ask your G-E sales engineer to do it for you. Then check your utility power contract and see how much you will save by raising your power factor. You and your sales engineer will be able to determine *in advance* how much you will receive in dividends on your investment in General Electric capacitors. For more information, write for Bulletin GEA-5632, "How To Use Capacitors." General Electric Co., Section 441-113, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

"It's a pleasure to do business with Day-Brite"



Mr. Robert L. Cooper, Baldwin-Stewart Electric Co.
Hartford, Conn.

"Our dealings with Day-Brite have always been very satisfactory.

"We like the way they put out their catalog information. It's complete, easy to follow, gives us all the data we need.

"We like the attention of the Day-Brite representative. We like the way their distributor follows through. They're most helpful.

"And—we like the through-and-through quality of Day-Brite fixtures. They're designed for easy installation; help us turn in a finished job that pleases our customers.

"In short, it's a pleasure to do business with Day-Brite."

Hundreds and hundreds of contractors feel the same as Mr. Cooper. That's why Day-Brite continues to grow.

61160
DAY-BRITE LIGHTING, INC.
5402 Bulwer Ave. • St. Louis 7, Missouri

"DECIDEDLY BETTER"
DAY-BRITE
Lighting Fixtures

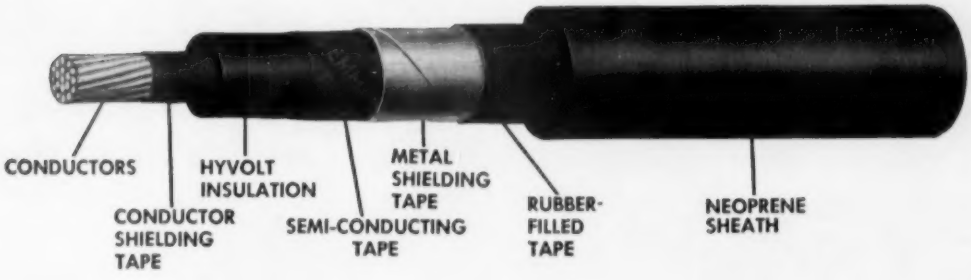
Certified Lighting for a Better America

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

CRESCENT

OVER 70 YEARS EXPERIENCE

HYVOLT SHIELDED POWER CABLE



For More Amperes Per Dollar of Installed Cost

ADVANTAGES

1. Long life
2. Can be operated at 85°C. Permits smaller conductors or more amperes per conductor.
3. Freedom from corona cutting
4. Excellent resistance to moisture
5. Low power factor and dielectric loss
6. Lighter, more flexible, easier to handle and install than lead covered cables
7. Electrolytic or chemical corrosion of lead sheath is eliminated by use of neoprene sheath
8. Shielding prevents possibility of surface burning and provides safety to human life.

CRESCENT HYVOLT insulation is made from butyl rubber which is inherently resistant to ozone, heat, moisture and aging. HYVOLT is formulated and processed so as to retain these inherent characteristics of the butyl rubber and at the same time provide excellent electrical and physical properties.

The insulation is protected during and after installation by an outer neoprene sheath providing a maximum degree of toughness, durability and long life. It is flame retarding and resistant to the deteriorating effects of moisture, sunlight, ozone (corona), oil, grease, and many acids and alkalies.

HYVOLT Shielding provides additional internal and external protection in these THREE WAYS

1. Conductor shielding, as provided by a semi-conducting tape over the stranded conductors, excludes air pockets between conductor and insulation and eliminates possible internal corona-cutting of the insulation.
2. The semi-conducting tape between the insulation and metallic shielding tape prevents possible ionization of air spaces and corona at the insulation surface.
3. The metallic shielding tape is grounded when installed, resulting in zero potential to ground at the sheath. It prevents surface discharge or burning, and protects cable from lightning surges. Reduces shock hazard.

RECOMMENDATIONS

CRESCENT SHIELDED HYVOLT CABLE is recommended for use in conduits, underground ducts, in wet or dry locations, or buried directly in the ground, for circuits operated at over 3000 volts and in accordance with I.P.C.E.A. recommendations. Available in single conductor or multi-conductor cables.

Specify CRESCENT SHIELDED HYVOLT POWER CABLE for general power circuits and where severe conditions are prevalent such as chemical plants, refineries, paper mills, mines, sewage disposal plants, etc. It is approved as Airport Lighting Cable Type B, CAA Specification L-824.

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON 5, N. J.

Why Sorgel dry-type transformers were selected

for the two largest buildings erected in New York City since the war

SOCONY MOBIL BUILDING, the largest air-conditioned office building in the world.

Architects: Harrison & Abramovitz.
Associate Architect: John B. Peterkin.
Electrical Engineer: Edward E. Ashley.
Electrical Contractors: Fischbach & Moore, Inc.

Higher Voltage Electrical Distribution

Higher voltage distribution, with dry-type transformers at load centers, which we have been advocating for years, is now recognized as the most efficient and economical method of interior electrical distribution. It has been adopted for the Socony Mobil Building and the new Coliseum in New York City.

NEW YORK COLISEUM, the largest exhibition building of its kind in the world.

Architects: Leon and Lionel Levy, with Aymar Embury II, Otto Eggers of Eggers & Higgins, and John B. Peterkin, as a consulting and advisory committee.
Engineer: Guy B. Panero.
Electrical Contractors: Jackson-Livingston.

Most Quiet Operation Demanded

The engineers' principal requirement was that the transformers have a low sound level. Regular tests, made in our laboratory, prove that the sound level of SORGEL dry-type transformers is well below the established standards. Because of their unusually quiet operation, SORGEL transformers are particularly adaptable for any indoor installations.

Liberal Design for Full Rated Load

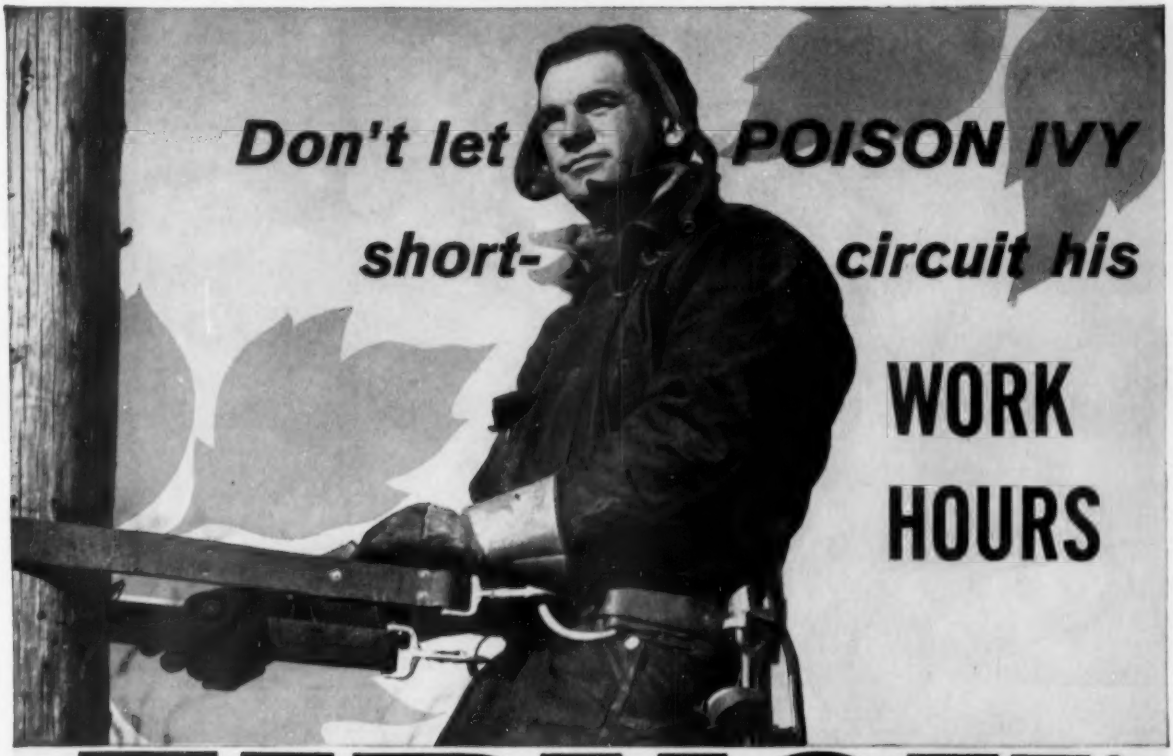
SORGEL dry-type transformers are guaranteed to carry the full load continuously at a safe, low operating temperature. They are so liberally designed that they can safely carry an overload during an emergency.

SORGEL TRANSFORMERS

Tested and approved by Underwriters' Laboratories under the Re-examination Service

SORGEL ELECTRIC CO., 836 West National Ave., Milwaukee 4, Wisconsin

Sales Engineers in Principal Cities



ZIRNOX®

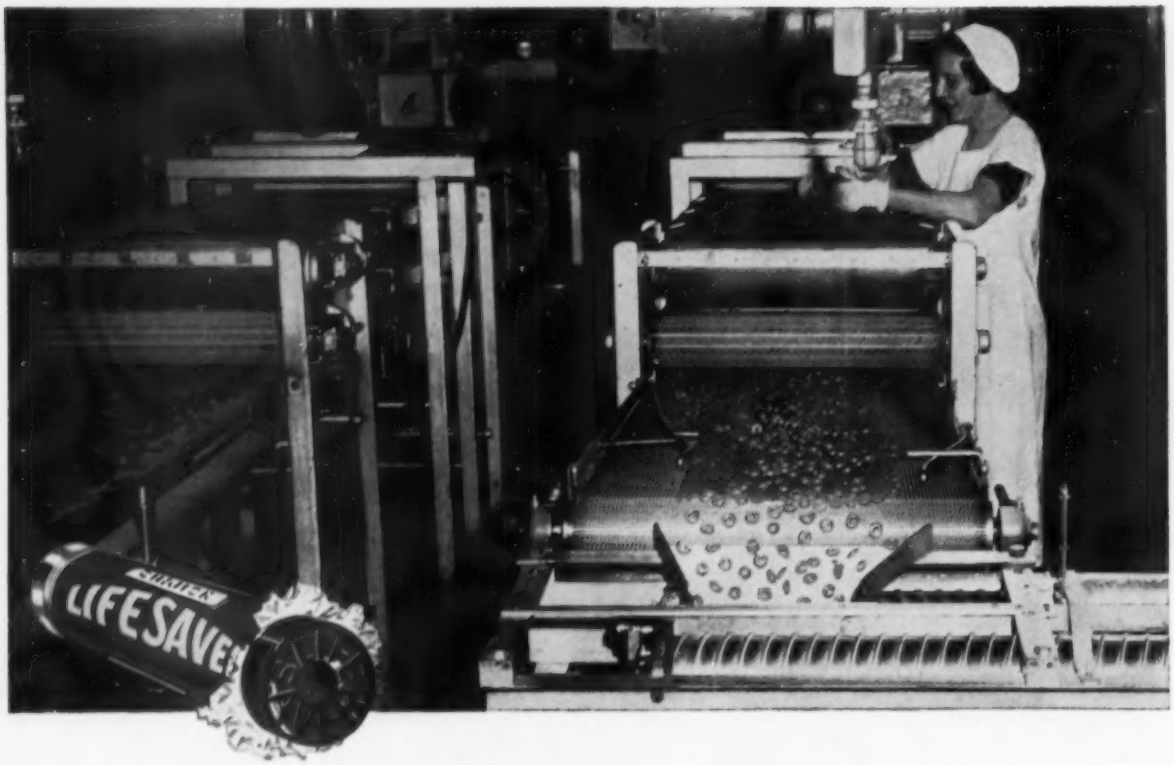
can be relied on for effective

PREVENTION: Effectively wards off poison ivy, poison oak, poison sumac
— if applied before exposure
— or within eight hours *after* exposure

RELIEF: Eases itching and retards spread
— if applied in early stages

Contains hydrous zirconium oxide 4%, Bristamin dihydrogen citrate 1%, in a non-greasy lotion base.

Bristol
LABORATORIES INC
SYRACUSE, NEW YORK



CLARK Type "CY" Starters help Life Savers maintain pre-war price "...still only 5¢!"

Despite raw material and labor cost increases of several hundred percent since 1913, Life Savers Corporation has held the cost of their popular candy package to a nickel. *How?* By increased productivity and increased efficiency in production processes.

Practically all of the control equipment at the company's spotlessly clean, automatic Port Chester plant is by Clark. And, as worn out or outdated equipment is replaced, Clark is chosen. R. D. Farrant, chief electrician, tells one of the reasons why: "Clark starters have everything any other starters have, plus simplicity of changing all parts and ease of maintenance. I particularly like the way the arc shield drops down for easy inspection of contacts."

Write for complete information about the revolutionary Clark Type "CY" starters.

R. D. Farrant, chief electrician, checks installation of 20 Clark Bulletin 6013 Type "CY" size 1 starters on a new panel.

The **CLARK** **CONTROLLER** *Company*

Engineered Electrical Control

1146 East 152nd Street • • Cleveland 10, Ohio

IN CANADA: CANADIAN CONTROLLERS, LIMITED • MAIN OFFICES AND PLANT, TORONTO

FITTING WORDS TO REMEMBER . . .

KILLARK ELECTROLETS offer you constant UNIFORMITY & PRECISION

"Precision" and "uniformity" are no sometime-features in Killark Electrolets . . . but rather fitting-after-fitting characteristics that have become a proud and vital part of *all* Killark production.

What does this unvarying quality mean to you? It means that any Killark fitting is completely interchangeable with another of its type on any job; it means close-fitting covers, conduit pipes, plugs and other accessories; and it means accurate threads that won't strip or bind on the job. Add it all up and it means a faster, neater job with consequential savings in time, labor and materials.

K Killark

KILLARK ELECTRIC MANUFACTURING COMPANY

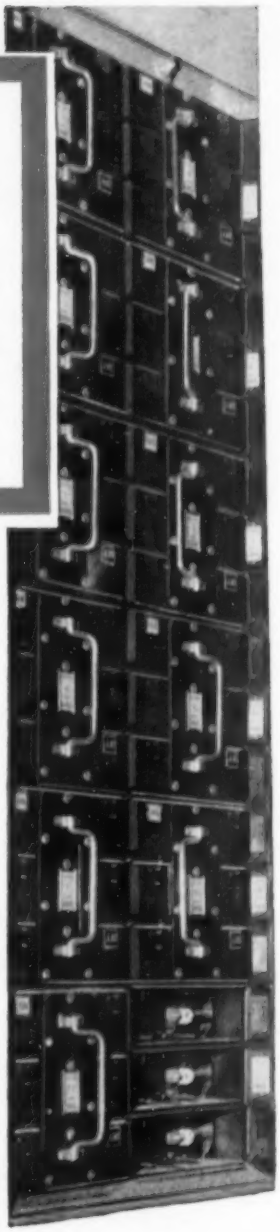
Vandeventer and Easton Aves. St. Louis 13, Missouri

SALES OFFICES and WAREHOUSE STOCKS	Atlanta	69 Mills St., N. W.	Dallas	1901 Griffin St.	Philadelphia	2014 Chancellor St.
	Boston	49-51 D St.	Denver	1073 Galapago	Pittsburgh	4830 McKnight Road
	Buffalo	278 Johnson St.	Detroit	8319 Mack Ave.	San Francisco	714 Harrison St.
	Chicago	1528 West Adams St.	Los Angeles	412 Seaton St.	Seattle	4130 First Ave., So.
	Cincinnati	1031 Meta Dr.				
SALES OFFICES	Baltimore	11 W. 25th St.	Kansas City, Mo.	616 W. 26th St.	New York	600 W. 181st St.
	Columbus	2700 E. Main St.	Minneapolis	826 Andrus Bldg.		

Sales Offices and Warehouse Stocks throughout Canada

. . . "After these two experiences with FUSETRON dual-element Fuses, we use them throughout our Entire Plant."

J. W. Sanders, CHIEF ELECTRICIAN
(Division of Simmons Co.) ROSEMARY MFG. CO.
ROANOKE RAPIDS, N. C.



"SOLENOIDS WERE BURNING UP AND STARTING *FIRES* — *Until we changed to FUSETRON FUSES.*"

"A fire in our weaving room is just about the gravest danger we can face. If the fire isn't checked immediately, it can quickly spread throughout the room.

"You can imagine then how concerned we were with fires started by solenoids burning up in heavy lint locations. With 500 looms in use in 3 weaving rooms, we didn't know where to expect the next fire.

1

"We definitely had to find safer solenoid protection than we were getting from one-time ordinary fuses in use. We decided to try Fusetron dual-element fuses and installed them in the summer of 1954.

"It was a big relief when Fusetron fuses turned out to be the answer. I'll knock on wood, but we haven't had a fire since we installed them.

"In addition, this move to Fusetron fuses also cut production costs. We eliminated needless down-periods and we no longer have to repair or replace burned-out solenoids."

"WE CUT UNNECESSARY DOWN-TIME AND MAINTENANCE *COSTS By installing FUSETRON FUSES.*"

"Several years ago we had a heating problem in our main panels that was causing ordinary renewable fuses to blow.

"These outages occurred several times weekly in each panel, so down-time costs were really adding up and costing our company money.

"Also, after each blow our maintenance men would spend time checking the circuit for trouble, only to find the outage was caused by excessive heating in the panel.

2

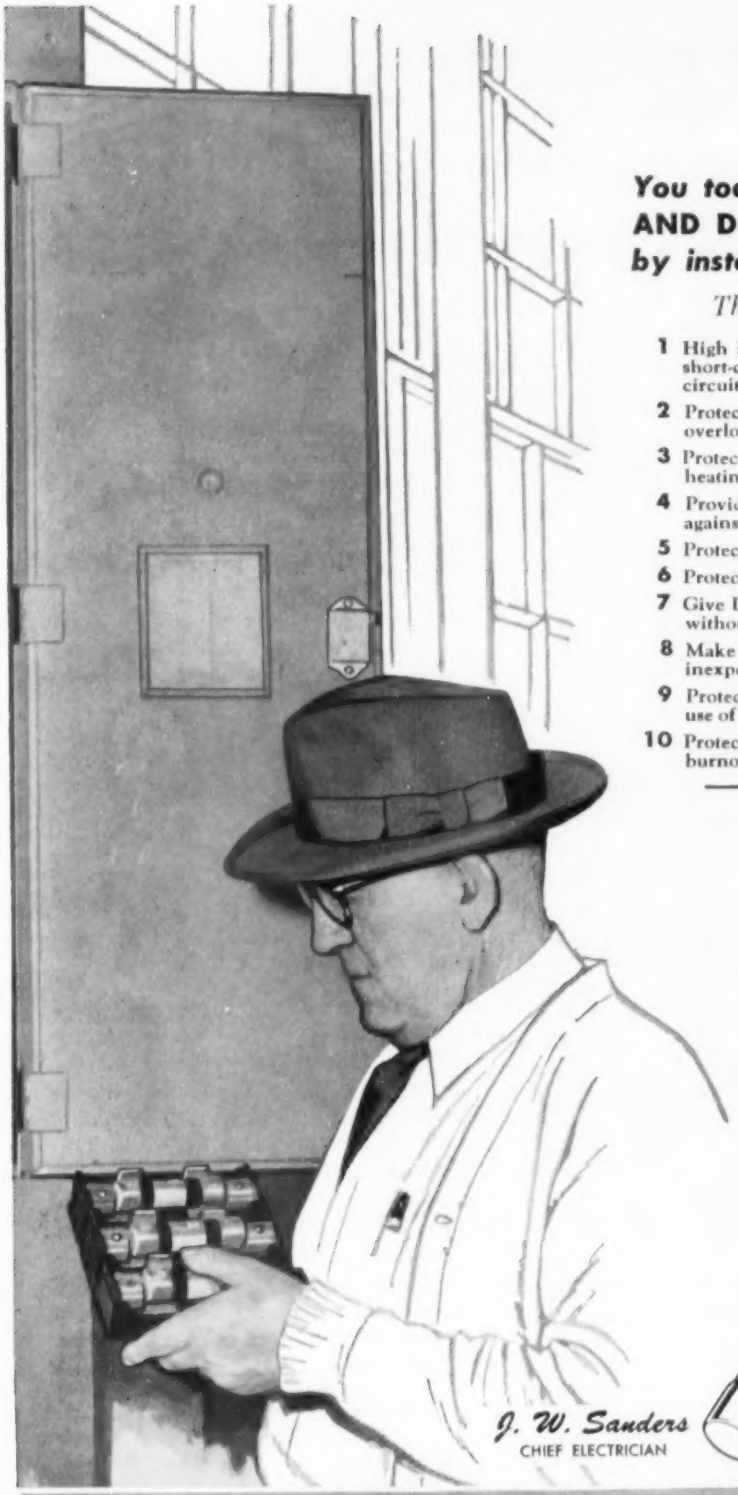
"We discussed the situation with a salesman and he showed us that Fusetron dual-element fuses were cooler operating and would eliminate our trouble.

"They sure did! The change to Fusetron fuses of proper size for safe protection was completed in 1953. We haven't had any unnecessary shut-downs since then.

"Our maintenance men sure like the change. Any outage today indicates trouble, and the men know they are not wasting time when they check the circuit.

"Because of this and other satisfactory experiences with Fusetron fuses, we individually protect all our motors with them as well as using them throughout the rest of the electrical system.

"I wish we had kept a record to show how much money we saved by equipping each motor with Fusetron fuses. I am reasonably certain that the difference in motor burnouts alone would represent considerable money."



You too, CAN REDUCE FIRE HAZARDS AND DOWN-PERIODS *by installing FUSETRON FUSES!*

They provide 10 Point Protection

1. High interrupting capacity—protect against heaviest short-circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloads.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

——— *Write for bulletin FIS.* ———

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS., *Use BUSS Hi-Cap Fuses . . .*

They have an interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

Write for bulletin HCS.

J. W. Sanders
CHIEF ELECTRICIAN

Play Safe! Install FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!

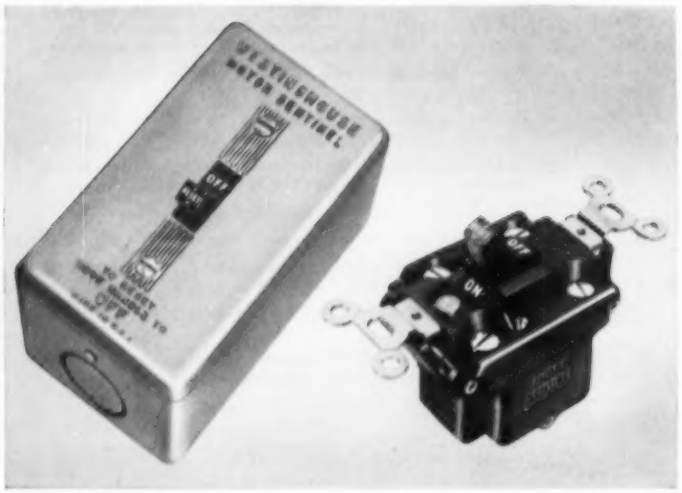
FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

BUSSMANN MFG. CO. Div. McGraw Electric Co.
University at Jefferson St. Louis 7, Mo.

Westinghouse manual controls...

today's greatest value

for more positive small-motor protection!



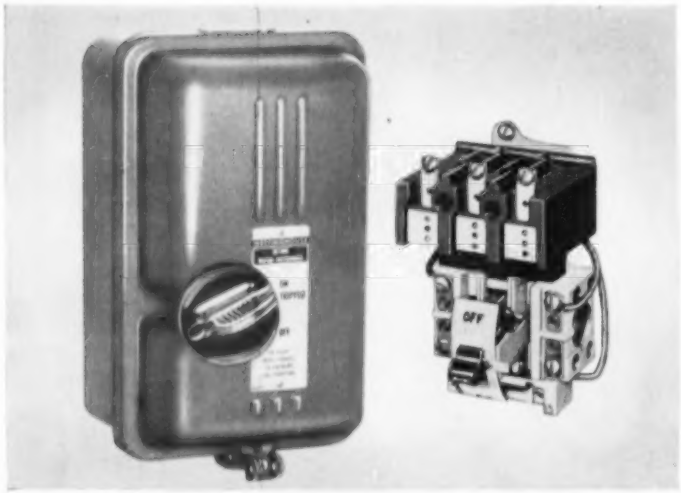
Motor Sentinel in NEMA 1 enclosure.

For ratings up to 1 hp

The Westinghouse Motor Sentinel* offers the most positive and permanent motor protection you can buy. Bimetallic overload protection, straight-through wiring, and many other outstanding extras add up to longer life, easier installation—greater savings for you in every way.

Available in single or double pole, for single-phase motor applications, in three NEMA enclosures—general-purpose, water- and dust-tight, and explosion-proof.

*Trade-Mark



De-ion® Motor Watchman in NEMA 12 enclosure.

Up to 7½ hp a-c or 2 hp d-c

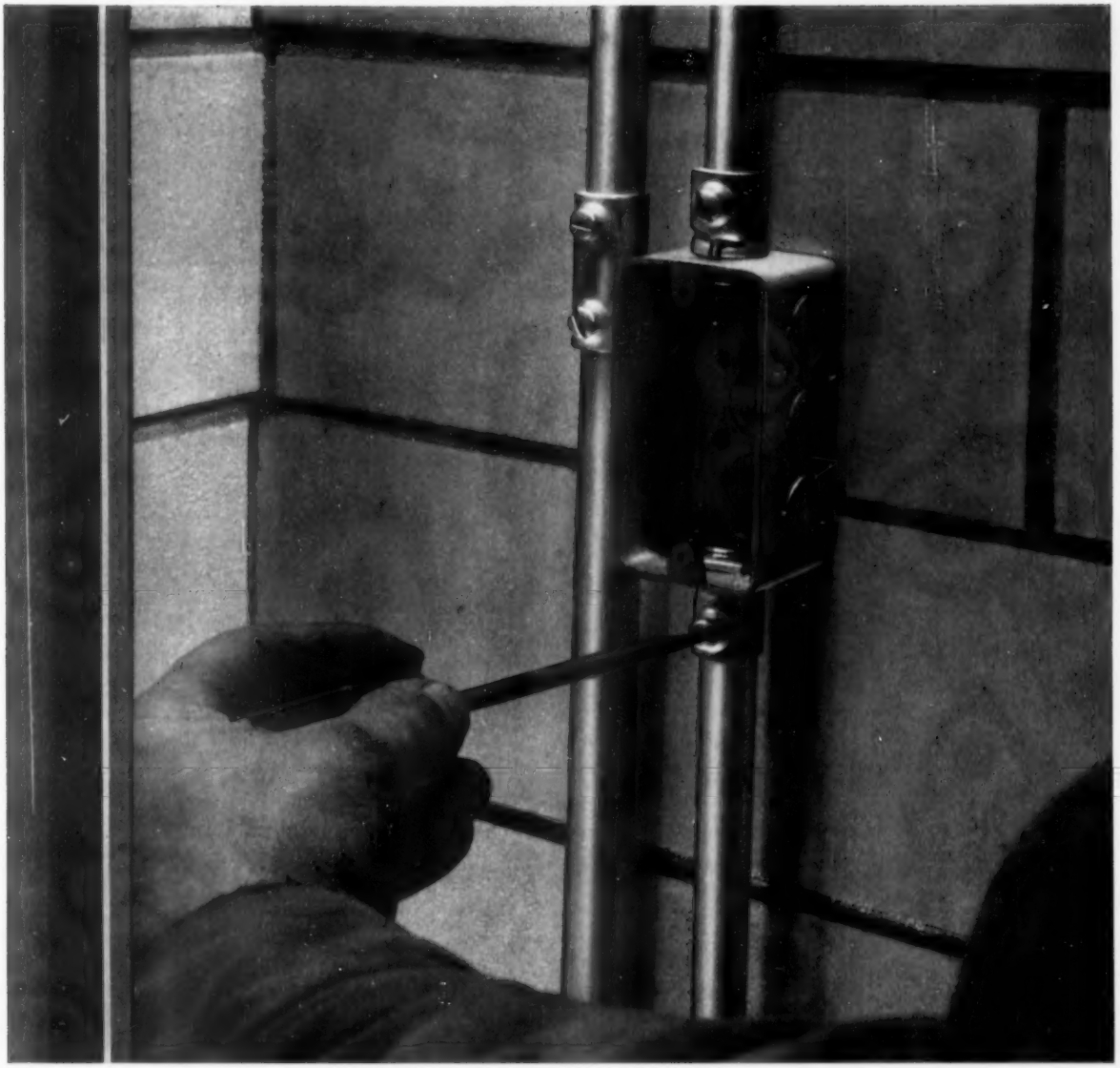
Snap-action, bimetallic disc—a Westinghouse exclusive—provides *absolute* motor protection. And you can rely on the Westinghouse Motor Watchman® indefinitely because, even after years of operation, the bimetallic disc retains its precise calibration—never needs adjustment.

Comes in new NEMA 12 enclosure and a wide range of other NEMA enclosures for various operating conditions.

For *all* the facts on Westinghouse manual controls, call the control sales engineer at your nearest Westinghouse office, *The Man With The Facts!* J-30188

YOU CAN BE SURE...IF IT'S

Westinghouse

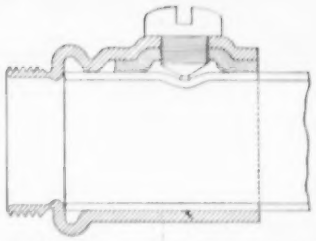


A screwdriver is all you need to install National Electric E. M. T. Fittings

Even in corners and other close locations, a screwdriver is your only tool for making connections with National Electric E.M.T. fittings. Simply slip the fitting over the end of the conduit and tighten the patented embedding screw. That's all there is to it.

You'll find National Electric connectors and couplings are safe and strong. The body is one sturdy piece of pressed steel, electrogalvanized for full protection against corrosion. The precision screw and boss make a uniform installation possible throughout the job. Inspection is easy and the contact of the screw constitutes a safe permanent ground.

National Electric E.M.T. fittings are the easy way to assure the quality of your connections. Try them . . . they're sold by the leading electrical distributors everywhere.



The outstanding holding action of National Electric Fittings is obtained when the tip of the screw is driven home and becomes embedded in the tubing wall. Actual tests prove the connection is a vibration proof bond that won't break or loosen unless the screw is purposely released.

Patent No. 2,455,180

National Electric Products

PITTSBURGH, PA.

3 Plants • 10 Warehouses • 36 Sales Offices

One in a series to emphasize the economy of Electrical Wholesale Distribution

He says he performs a vital economic function which some people strangely think can be ignored... Hmmm....
He reduces hidden costs for electrical users, and gives advice and technical help—but isn't a philanthropist or magician. Hmmm....
He cuts electrical manufacturers' costs of distribution—with resulting lower prices to the user—but he isn't an industrial engineer. Hmmm....
He substitutes for hundreds of manufacturers' salesmen—but he isn't Superman. I give up!
GUESS MY LINE
Shucks, any smart electrical user would know he's a Distributor!

"Electrical Wholesaler Distribution reduces the Manufacturer's selling cost and thereby reduces the selling price of electrical supply material to the user. Therefore, our policy has been to distribute Thomas & Betts products exclusively through the Electrical Wholesaler."*

LOOK FOR THIS SIGN — AUTHORIZED DISTRIBUTOR T&B ENGINEERED

IT'S THE MARK OF AN AUTHORIZED **T&B** DISTRIBUTOR

THE THOMAS & BETTS CO.

INCORPORATED

34 BUTLER STREET, ELIZABETH 1, NEW JERSEY

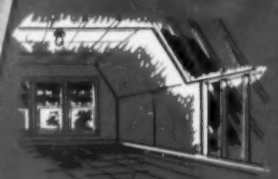
THOMAS & BETTS, LTD., MONTREAL, P. Q., CANADA

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

*Quoted from the T & B Plan of Wholesaler Distribution. If you would like to know the complete story of the T & B Plan, write:

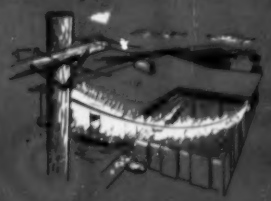
. . . I *recommend*
CLIFTON Current Carrying Products
every chance I get!

Here is the famous CLIFTON trio to carry the current from the pole to its end use in the building. Each is made for use anywhere in the country and is unaffected by atmospheric changes and extremes of heat and cold. So wherever you live and work the CLIFTON trio protects your jobs like nothing else.



Clifton Service Entrance Cable

CLIFTON Unarmored Service Entrance Cable in 2 and 3 conductor is absolutely impervious to moisture. Special rubber coated "Mylar" tape insures a long useful life.



Cliftall UF Cable

CLIFTALL UF is an all-purpose cable, designed for circuits through masonry, wall tiles or imbedding in plaster in moist, damp or corrosive locations. CLIFTALL, available in 1, 2 or 3 conductor, is insulated with 2 layers of high quality thermoplastic, separated with reinforced fibreglas.

CLIFTX Non-Metallic Sheathed Cable is perfect as a general purpose wiring for carrying the current load throughout the building. Protected against moisture and rot, CLIFTX is made with tightly braided fibreglas covering saturated with an asphalt compound, silver finished, and further protected with a thin coating of high melting point wax.

Cliftx Non-Metallic Sheathed Cable

Your Best 2 Word Specification
CLIFTON CONDUIT

Other CLIFTON *Quality Products:*
CLIFTON Plastic Covered Steel Conduit
CLIFTON Armored Cable CLIFTON Building Wire TW-R-RHRW-S-SJ
CLIFTON Elbows and Couplings CLIFTON Rigid Conduit
CLIFTON EMT CLIFTON Flexible Steel Conduit

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WIRE — CABLE — RIGID CONDUIT — ELECTRIC METALLIC TUBING — CLIFTALL UF

Wagner TRANSFORMERS...THE CHOICE OF LEADERS IN INDUSTRY

Where uninterrupted power is a must...

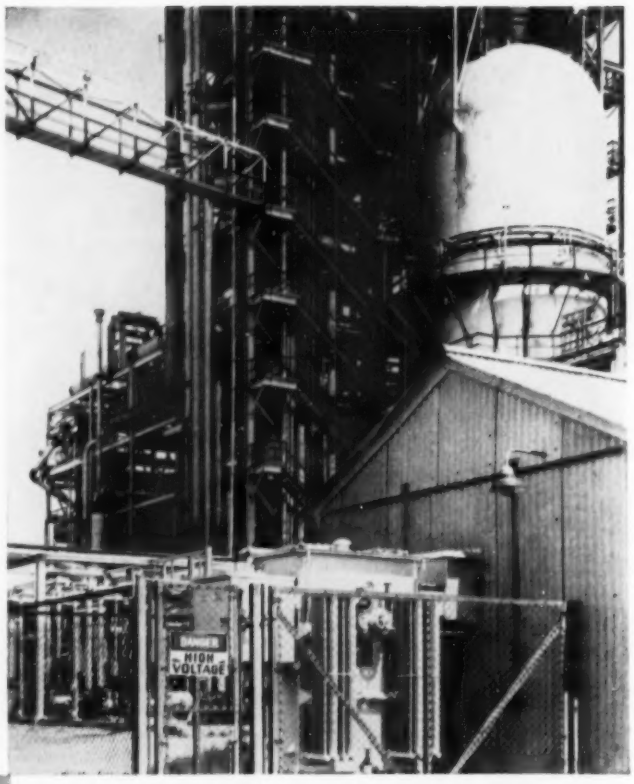
WAGNER UNIT SUBSTATION TRANSFORMERS

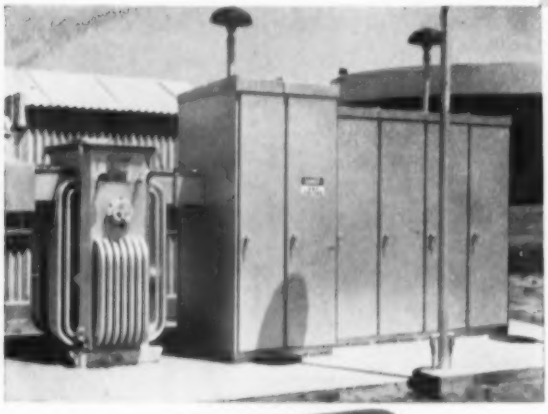
A completely dependable power supply is a vital necessity to an oil refinery. A power interruption of only a few minutes on a "cat cracker," like the one shown at the right, would completely disrupt this important processing operation and cause a shut-down of the entire refinery.

That's why you'll find Wagner Unit Substation Transformers at work at the Carter Oil Company refinery at Billings, Montana.

Wagner transformers are often found in installations where power supply failure would incur great loss because they have a reputation for complete dependability—backed by sixty-five years of transformer building experience.

Wagner Unit Substation Transformers, both liquid-filled and dry-type, are carefully designed to meet distribution requirements. Both liquid-filled and dry-type unit substation transformers are built in ratings through 2000 kva, 15 kv and below—you can choose the type and rating that exactly meets your load-center distribution requirements. Call the nearest of our 32 branch offices, or write us.





The 750 kva, 2400/4160Y to 480 volt, 60 cycle, three-phase, liquid-filled Wagner Unit Substation Transformer feeds the catalytic unit at The Carter Oil Company refinery. At left is shown a 225 kva Wagner substation transformer connected to an outdoor substation at the same refinery. Purchased and installed by The Fluor Corporation, Ltd., Engineers and Constructors for the Petroleum, Chemical and Power Industries, Los Angeles.

* * *

Write for Bulletins TU-205 and TU-214. They give full information on Wagner Unit Substation Transformers. Consult the nearest of our 32 branch offices about your next transformer installation.

Wagner Electric Corporation EST. 1891

...to help America LIVE BETTER—*Electrically*

LIVE BETTER ELECTRICALLY

Wagner Electric Corporation
6413 Plymouth Ave., St. Louis 14, Mo., U.S.A.

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WT56-9

if it's a fitting . . . Efcor

including the new

ADEQUATE WIRING

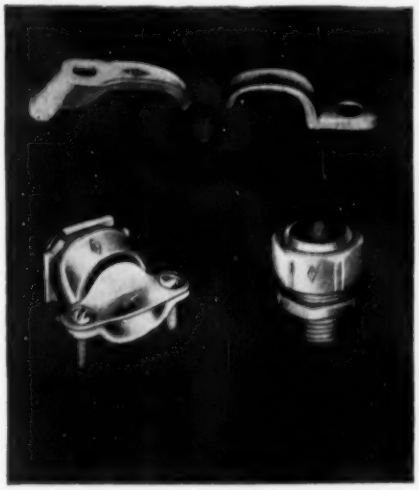
sizes . . .

2 - #3 and 1 - #5
2 - #3 and 1 - #3
2 - #2 and 1 - #4
2 - #1/0 and 1 - #1/0

service entrance cable sizes with applicable Efcor fittings . . .

CABLE SIZE	SERVICE ENTRANCE CAP	STRAP	NON WATERTIGHT CONNECTOR	WATERTIGHT CONNECTOR
1 #12 & 1 #12	ESC 802	860	1111	839
1 #10 & 1 #10	ESC 802	860	1111	839
1 #8 & 1 #8	ESC 5	860	1111	838
1 #6 & 1 #8	ESC 5	860	1111	838
1 #6 & 1 #6	ESC 5	860	1111	838
1 #4 & 1 #6	ESC 5	860	1212	—
1 #4 & 1 #4	ESC 5	19	4234	—
1 #2 & 1 #4	ESC 5	230	4234	—
1 #2 & 1 #2	ESC 5	230	4234	—
2 #12 & 1 #12	ESC 5	860	1111	—
2 #10 & 1 #10	ESC 5	861	1111	—
2 #8 & 1 #8	ESC 5	861	1234	850
2 #6 & 1 #8	ESC 5	861	1234	851
2 #6 & 1 #6	ESC 5	861	1234	840
2 #4 & 1 #6	ESC 5	861	3410	849
2 #4 & 1 #4	ESC 5	861	3410	849
2 #3 & 1 #5	ESC 5	861	3410	854
2 #3 & 1 #3	ESC 5	861	3410	854
2 #2 & 1 #4	ESC 803	862	1015	859
2 #2 & 1 #2	ESC 803	862	1015	859
2 #1/0 & 1 #1/0	ESC 804	23	1015	858

Figures in blue denote new "Adequate Wiring" service entrance cable sizes



First and foremost in fittings—sold exclusively through electrical wholesalers

Efcor

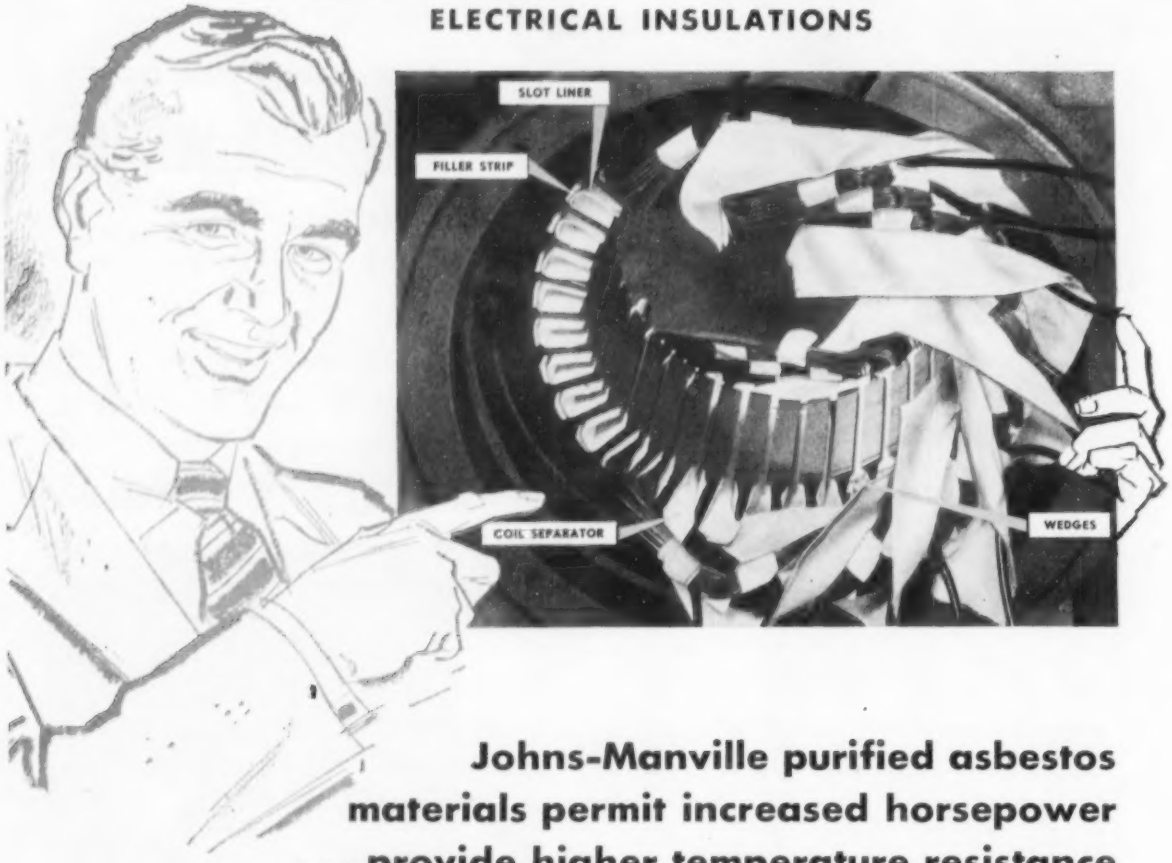
ELECTRICAL FITTINGS CORPORATION
Dept. A, 37-50 57th St., Woodside 77, New York
Send complete data on service entrance cable fittings.

NAME _____ TITLE _____
FIRM _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

Smaller motors carry bigger loads when you insulate with

Quinterra®

ELECTRICAL INSULATIONS



Johns-Manville purified asbestos materials permit increased horsepower . . . provide higher temperature resistance

MOTORS insulated with Quinterra will outperform others of substantially higher rating but with less heat-resistant insulation.

The above photograph shows how you can use *Quinterra* and its companion product *Quinterrabord*® on a standard Class H induction motor. *Quinterra* Type 3-GR was employed for slot liners and coil separators. Wedges and filler strips are of *Quinterrabord* Type 3. Both materials are made from highly purified asbestos fibres treated with silicone resin for the highest combination of dielectric strength and pyrolysis resistance obtainable. In addition, Type 3-GR is reinforced with a strengthening layer of fine glass cloth.

Johns-Manville has developed a complete line of *Quinterra* materials for application in motors, transformers and other electrical apparatus. For further information write for brochure EL-40A. Address Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE PRODUCT

Johns-Manville ELECTRICAL INSULATIONS

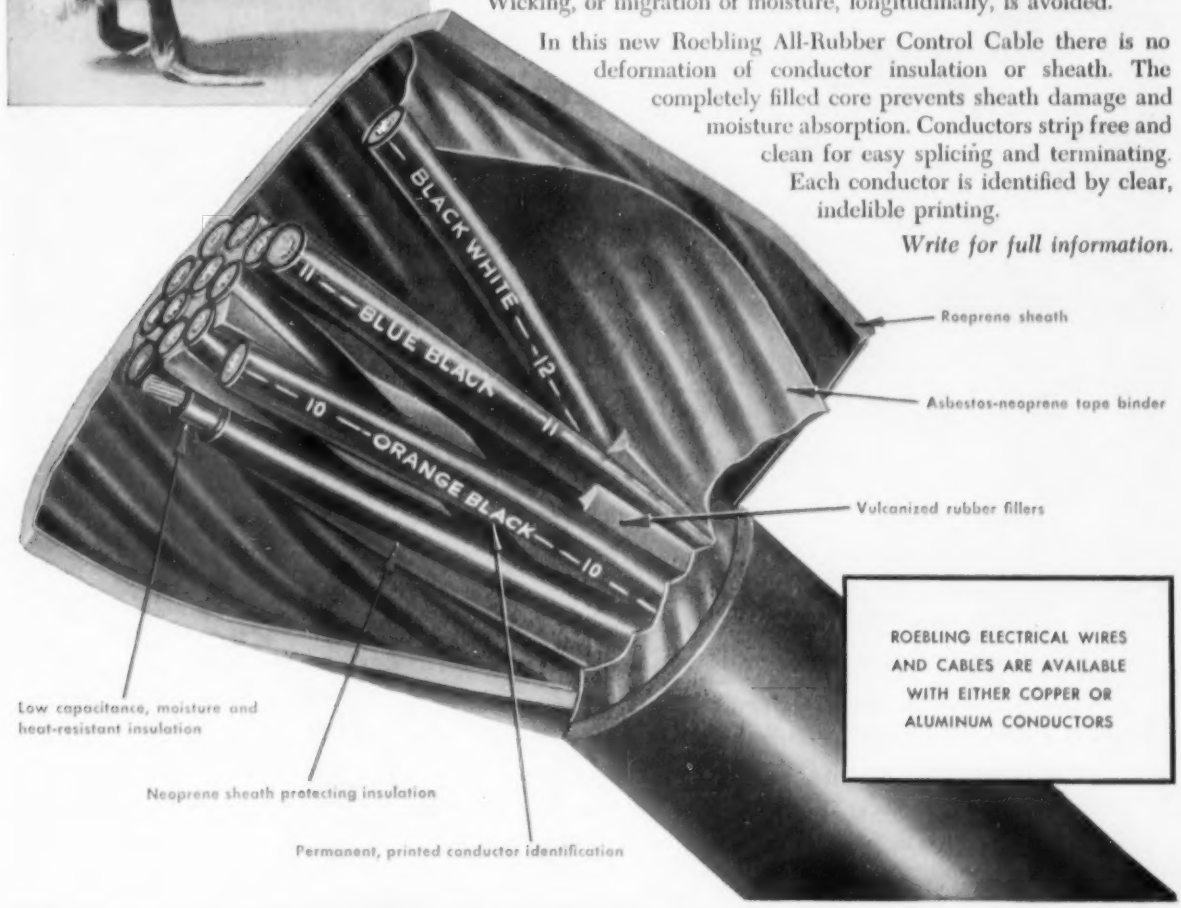
IF YOU THINK **DUCKS** *ARE MOISTURE-RESISTANT,*
GET ACQUAINTED WITH THIS NEW

ROEBLING ALL-RUBBER CONTROL CABLE

HERE'S A NEW CONTROL CABLE entirely built of non-hygroscopic materials. Conductors are covered with a special low capacitance moisture and heat-resistant insulation. In addition the insulation on each conductor is protected by a neoprene jacket. Rubber fillers are vulcanized and completely fill all interstices. Asbestos-neoprene tape binds cable core during processing and becomes an integral part of the tough, overall, Roeprene sheath. Wicking, or migration of moisture, longitudinally, is avoided.

In this new Roebling All-Rubber Control Cable there is no deformation of conductor insulation or sheath. The completely filled core prevents sheath damage and moisture absorption. Conductors strip free and clean for easy splicing and terminating. Each conductor is identified by clear, indelible printing.

Write for full information.


BLACK WHITE — 12
11 — BLUE BLACK
10 — ORANGE BLACK — 10
Roeprene sheath
Asbestos-neoprene tape binder
Vulcanized rubber fillers
Low capacitance, moisture and heat-resistant insulation
Neoprene sheath protecting insulation
Permanent, printed conductor identification

ROEBLING ELECTRICAL WIRES AND CABLES ARE AVAILABLE WITH EITHER COPPER OR ALUMINUM CONDUCTORS

ROEBLING

Subsidiary of The Colorado Fuel and Iron Corporation

JOHN A. ROEBLING'S SONS CORPORATION, TRENTON 2, N. J. BRANCHES: ATLANTA, 934 AVON AVE. • BOSTON, 11-15 STILLING ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 2340 GLENDALE-MILFORD RD., EVENDALE • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. ODESSA, TEXAS, 1930 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • PITTSBURGH, 1723 HENRY W. OLIVER BLDG. • SAN FRANCISCO, 1740 17TH ST. SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, 19 RECTOR ST., NEW YORK 6, N. Y.

How to Lend Added Lure to Today's Cars Effectively yet Unobtrusively with Lighting by **LITECONTROL**

In this automobile showroom, LITECONTROL'S 5100 series fixtures were employed to accent the natural glamor of the cars. The low brightness lenses provide a high level of illumination while reducing glare to a minimum, and the fixtures blend quietly into the ceiling yet assure quality illumination.

Thanks to Litecontrol's exclusive trigger catches, fixture doors are easy to open, easy to close and easy to remove — hence very easy to clean and service. Gentle fingertip pressure on easily accessible levers opens the doors — to close, just push them back in place. To remove — door is easily lifted out of the housing enclosure. Fixture finish is long-wearing baked white enamel.

Whether you are planning a lighting installation for a showroom, office, store or library, consider LITECONTROL. You will obtain superior lighting at *standard* fixture costs.

INSTALLATION: A. W. Golden, Inc., Cadillac-Pontiac Agency, Reading, Penna.

ARCHITECT: Carl A. Eisenhower, Reading, Penna.

ENGINEER: J. L. Medlar, Reading, Penna.

CONTRACTOR: Acme Electric Co., Reading, Penna.

DISTRIBUTOR: Graybar Electric Co., Reading, Penna.

FIXTURES: LITECONTROL No. 5134 recessed slimline fixtures with Holophane #6016 low brightness plastic controlenses® in hinged doors with Trigger Catches.

INTENSITY: Approximately 55 footcandles average in service, not including incandescent equipment.

®R Holophane Co., Inc.

LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

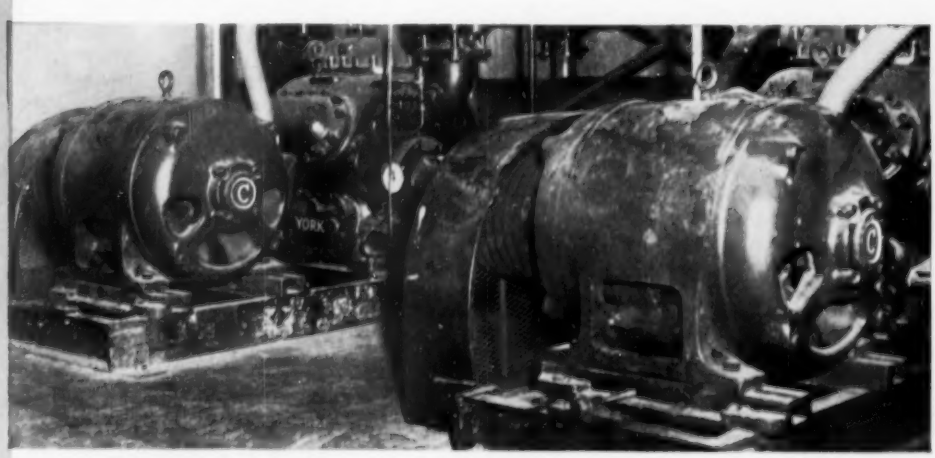
DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

Special low-current starting costs less WHEN YOU SPECIFY

Century PART WINDING START MOTORS

Here's the easy and inexpensive answer to having big motors that will start easily when starting current is limited. Part winding starting is available on all popular size Century motors up to 400 H.P., polyphase, in drip proof, totally enclosed and explosion proof frames, horizontal or vertical mounting.

For fast service from stock, call your nearby Century Distributor or Century District Sales Office.



Two 50 H.P. Century Part Winding Start motors power these unloading type air conditioning compressors. When starting, just half of the winding is energzied, drawing less than two-thirds of normal starting current. In a few seconds, the full winding is connected and the motor delivers full torque at full current.

Get your free copy of our bulletin: "Where Low Starting Current is Required." Mail this coupon today . . .

To CENTURY ELECTRIC COMPANY
1806 Pine Street • St. Louis 3, Missouri

Please send copy of bulletin "Where Low Starting Current Is Required"

Name ..... *Title* .....

Company .....

Address .....

City ..... *Zone* ..... *State* .....

Performance Rated©
MOTORS
1/20 to 400 H.P.

CENTURY ELECTRIC COMPANY

1806 Pine Street • St. Louis 3, Missouri • *Offices and Stock Points in Principal Cities*

What's <u>your</u> loss to

"Do-it-yourself" wiring?

Many home owners, flush with success on other projects, may be tempted to try some "week-end" wiring. These jobs are rightfully yours. They call for the technical know-how that only you are qualified to provide.

Home modernization can help give your business a big boost. One survey estimates that 34 million homes in the U. S. need supplemental wiring. That doesn't include the million-plus housing starts expected every year.

It's good business to sell modernization with the most modern materials—wire and cable insulated with vinyl plastic, like that produced by Bakelite Company. This material makes possible easier, cleaner stripping and splicing than ordinary insulations because individual conductors in the cable have no braid or saturating compounds.

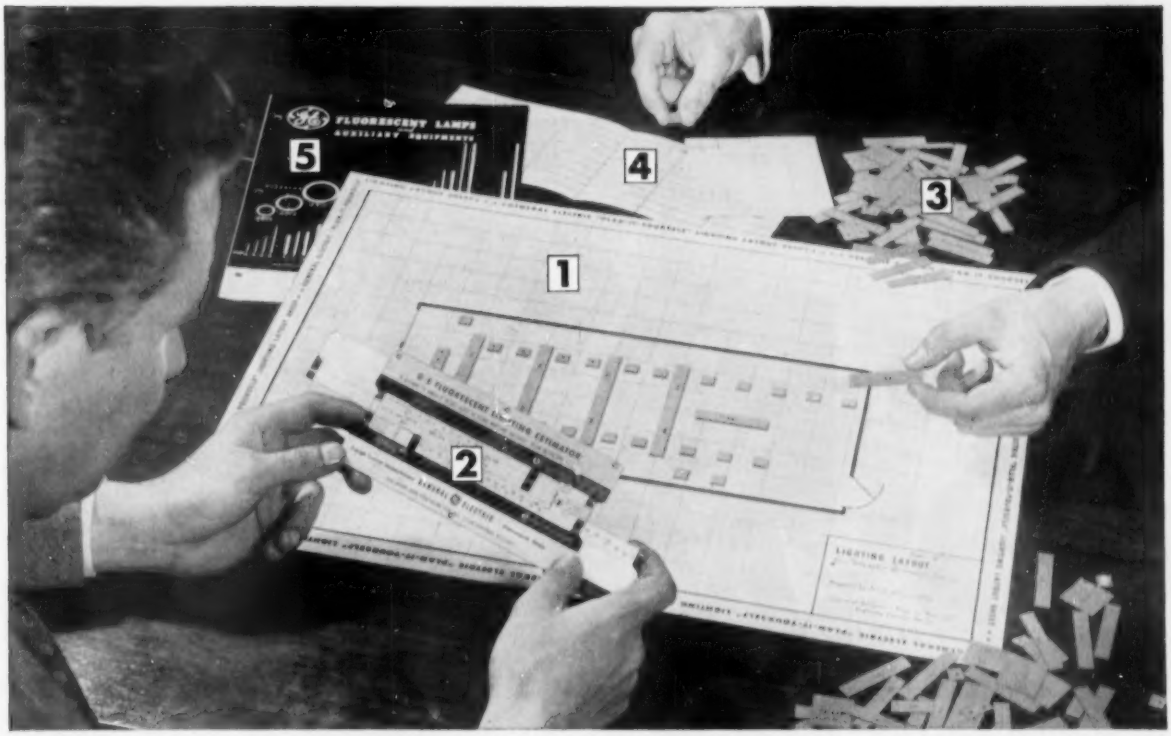
BAKELITE Brand Vinyl Plastic has another important selling point—resistance to aging. It keeps its electrical and physical properties longer because it resists cracking, stiffening, and oxidizing. BAKELITE Brand Vinyl Plastic is listed by UL for 60 deg. C. (140 deg. F.) building wire and for non-metallic-sheathed cable—including the new all-plastic types UF and NMC. Specify it for your next job.

Remember—everyone benefits from ADEQUATE WIRING insulated with BAKELITE Brand Vinyl Plastic

BAKELITE
BRAND
PLASTICS

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario
The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC

GENERAL ELECTRIC ANNOUNCES A NEW LAYOUT KIT TO MAKE YOUR LIGHTING JOBS EASIER TO SELL!



Your General Electric "Plan-It-Yourself" Lighting Layout Kit contains (1) layout sheets, (2) a fluorescent lighting estimator, (3) movable, scaled "fixtures", (4) gummed "fixtures" for your permanent layout, and (5) a lighting design guide.

Send for your new G-E "Plan-It-Yourself" Lighting Layout Kit today. It will help your lighting prospects sell themselves.

The G-E "Plan-It-Yourself" Lighting Layout Kit is a brand new idea that makes your selling more profitable because:

1. It makes your selling easier. Your prospect helps sell himself because he is in on the planning. He can visualize his lighting needs more easily.

2. You can "sell up". Because your prospect sees *why* the new layout fits his needs, you can sell him a better lighting job. *You make more profit!*

3. You'll "close" more sales. Once the layout is complete, your prospect okays it. Your sale is half closed even before a complete cost estimate is made.

4. Order your sales-building "Plan-It-Yourself" Lighting Layout Kit Today! Use it to make your next lighting job more profitable—more fun! Costs only $1.75—contains enough material for a dozen lighting jobs. **Mail the coupon below,** or see your G-E lamp supplier.

TO: General Electric, Large Lamp Dept., EC-7
Nela Park, Cleveland 12, Ohio.

Gentlemen:

Please send me _____ new G-E "Plan-It-Yourself" Lighting Layout Kits @ $1.75 per kit. I enclose $_____.

SEND TO: _____
(Please Print)

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

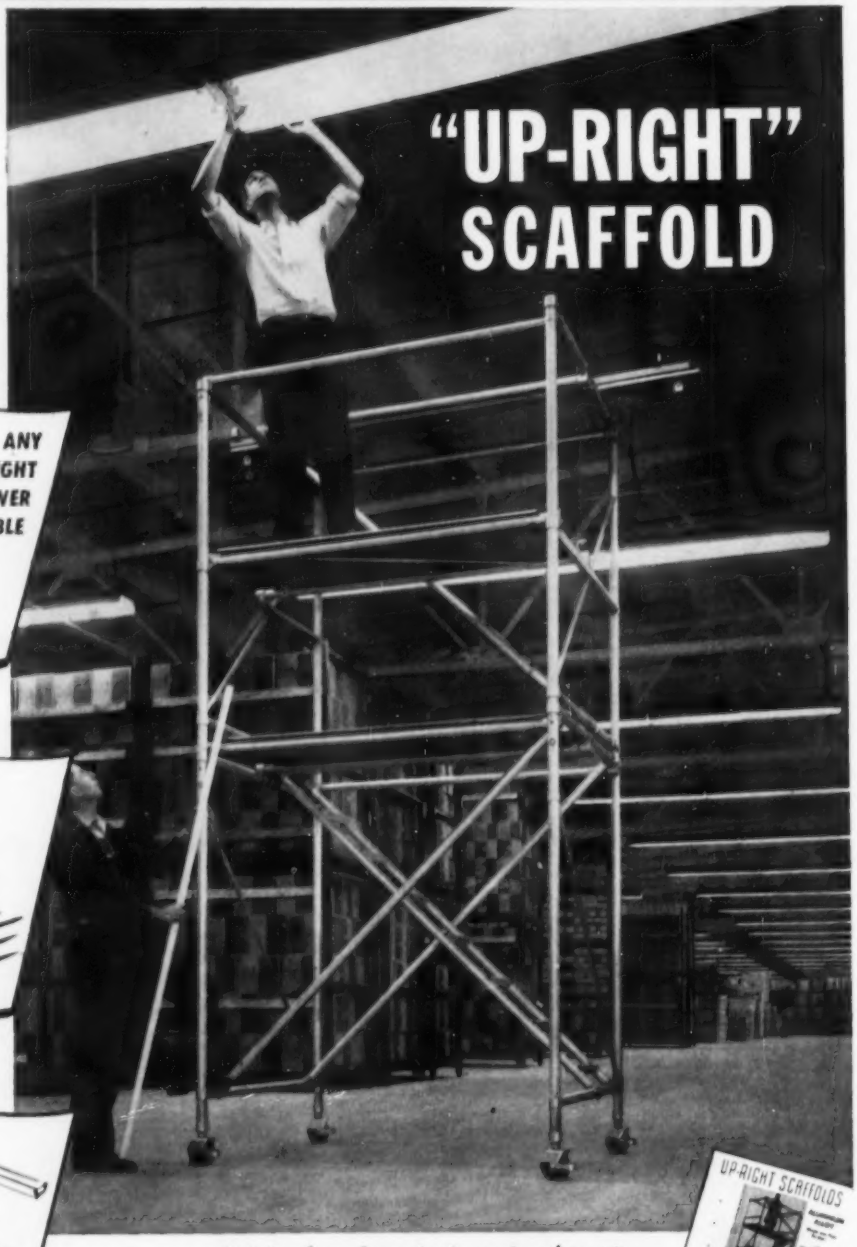
Progress Is Our Most Important Product

GENERAL ELECTRIC

WALTER D. VANCE, JR., *Vice President* • *California Electric Co., reports:*

"We saved 14 days installing 527 fixtures by using 'UP-RIGHT' Scaffold-on-Wheels"

Man-hour savings on this General Motors warehouse job amounted to over 40%. Up-Right Scaffold is so light it is easily assembled by one man. Individual 1 piece aluminum alloy sections are unfolded and set one on top of the other. They lock into place instantly.

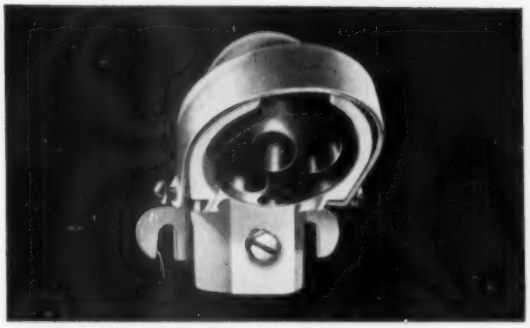


Write for descriptive circular ➡

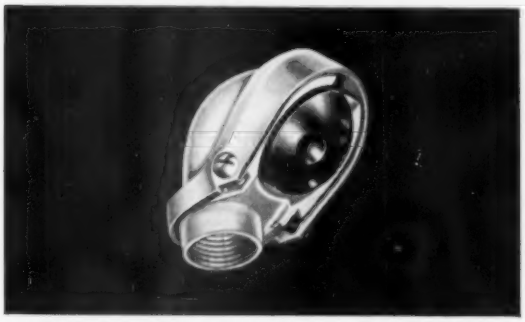
"UP-RIGHT" SCAFFOLDS

Dept. 159 • 1013 Pardee Street • Berkeley, California

Factories: Berkeley, Calif. and Teterboro, N. J. • Offices in all principal cities



"SPECIAL" ENTRANCE CAP for S.E. cables. With 5-hole insulator. Many inspection authorities require the use of special cables to meet particular requirements such as looking down a yard pole to meter box with a 5-conductor cable. Gedney, accordingly, designed this special entrance cap. Malleable iron; hot dip galvanized.



THREADED CONDUIT ENTRANCE CAPS Like most other Gedney entrance caps, this one is made of malleable iron to prevent breakage . . . hot dip galvanized for maximum service life. Sizes range from ½" to 6".

ENTRANCE CAPS for S.E. Cables—with key hole mounting bracket. Easy to assemble—cable slips into cap and is securely held by clamping shoe. Has split insulator and well bushed holes. Overlapping cover protects cables from weather. Malleable iron, hot dip galvanized.

Cross the threshold to lower costs...with

GEDNEY ENTRANCE CAPS

Malleable Iron–Hot Dip Galvanized

THESE ENTRANCE CAPS install faster—and cut your *final* costs right down to rock bottom. Like all Gedney Fittings they're accurately machined and threaded...smooth finished, with no burrs or metal particles. On top of that, the Gedney line includes many improved design features that bring extra efficiency and labor savings. For fittings that bring today's lowest installed cost, specify Gedney!

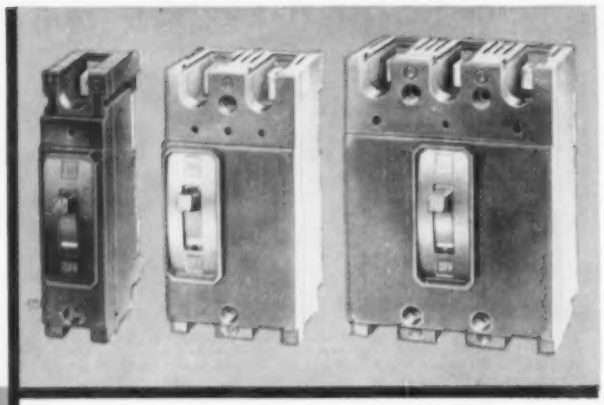
GEDNEY FITTINGS FIT

GEDNEY
ELECTRIC COMPANY

GEDNEY

RKO BLDG. • RADIO CITY • NEW YORK 20
Foundry, Factory and Shipping Point: Terryville, Conn.

I-T-E MOLDED CASE TYPE 'ET' CIRCUIT BREAKERS cover a range of needs, from the 'E' Frame 100-Amp 1, 2 and 3 pole breakers shown at the right to 'L' Frame 600-Amp 2 and 3 pole breakers.



BULLDOG POWER PANELS—

Compact Control Centers

EASIER TO INSTALL . . . FIT ALL NEEDS UP TO 600 AMPS.

Here's the way to provide efficient nerve centers for any commercial or industrial building! Compact BullDog Power Panels mount on walls where space is at a premium. And they combine built-in installation ease with the safety and performance "extras" of famed I-T-E molded case ET circuit breakers. BullDog Circuit Breaker Power Panels are today's last word in flexibility. They provide unmatched wiring gutter space, silvered buses throughout.

The molded case breakers provide unsurpassed overcurrent protection—with the ability to safely carry continuous current rating indefinitely. Magnetic, instantaneous trip insures split-second protection against shorts—thermal time delay trip guards against overloads.

Whether operated manually or automatically, the breakers perform *repeatedly* with high efficiency and safety, low watts-loss—features that rate high with your clients! Whatever the requirements, BullDog Power Panels meet them—from 100-amp light-duty to 600-amp heavy-duty service.

See your qualified distributor, BullDog field engineer —or write BullDog Electric Products Company, Detroit 32, Michigan.

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IF IT'S NEW . . . IF IT'S DIFFERENT . . . IF IT'S BETTER . . . IT'S

BULLDOG

ELECTRIC PRODUCTS COMPANY

A Division of I-T-E Circuit Breaker Company

Export Division: 13 East 40th Street, New York 16, N.Y. • *In Canada:* BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Road, Toronto 15, Ont.

ELECTRICAL CONSTRUCTION AND MAINTENANCE

55th Year— July • 1956

Service Responsibility

When B. L. England, president of the Atlantic City Electric Company, called upon electric utility executives at the EEI Convention last month to make reliability of service a major goal, he challenged a much larger audience. "As the values of electric power," he said, "in industry, in the community, in the home and on the farm were more and more realized, the role of electric power in our lives subtly—and rapidly—changed. People began increasingly to rely upon electricity, purchase equipment that would not work without its power, and to develop manufacturing and other processes that not only were dependent upon electric current, but which could be faced with ruin should that power cease for any appreciable time. The very life, the very safety of America, today depends upon a constant and uninterrupted flow of electricity."

Responsibility for service continuity in this era of electrical development is shared by every segment of this interdependent electrical industry. Outages on utility systems attract public attention because they sometimes affect a large group of customers at the same time. But continued improvements in line construction and advance emergency planning are cutting the incidence of utility failures and sharply reducing their scope and duration.

But what about outages on the load side of the meter? Such interruptions attract little public attention because they occur in individual premises at different times in different places. From the standpoint of the customer's essential utilization, however, they are just as inconvenient or costly as if the interruption occurred on the utility system. These emergencies, however, are too rarely anticipated by any plan or procedure.

For the most part, service continuity beyond the meter suffers no threat from the elements and can be readily insured by good design, competent installation and effective maintenance. Most outages within buildings are caused by faults and overloads easily anticipated or detected before they become emergencies or threaten vital utilization.

The utilities, engineers and contractors share a common cause in service responsibility. The extra margins of capacity, the extra quality of materials and components to assure uninterrupted utilization within buildings are neither difficult nor expensive to achieve. But they have to be sold and, in the process, protected against irresponsible chiseling which tries to make such values expendable for a price advantage.

Service responsibility is an industry-wide challenge and a rallying point about which there can be substantial agreement by all concerned in the public interest. The stakes may be far greater than we realize.

Wm. T. Stuart

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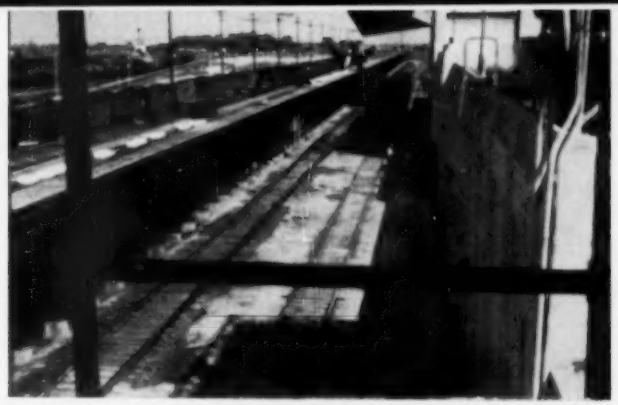


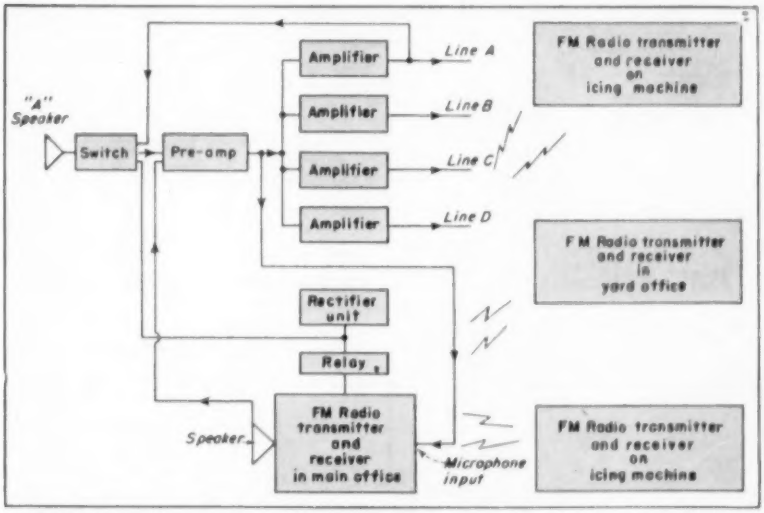
ICING MACHINE (arrow) is shown here from window of control tower. Machine is on tracks on top of icing dock. Ice can be seen on conveyor, moving toward machine.

An electrical contractor specializing in sound systems engineered this . . .

RADIO-LINK P.A. SYSTEM

RAPID and reliable communication is a vital link in the modernized refrigerator-car icing operation at the icing dock of Pacific Fruit Express in Fresno. Icing of trains, formerly done by large labor crews, is now performed by two mobile machines, each capable of taking ice from the delivery conveyors, crushing and placing it into the reefer bunkers at the rate of six tons per minute. Icing almost 700 cars in a single day with over 3,500 tons of ice demands constant control of the ice moving from the icehouse, through a tunnel under tracks, up the conveyor to the platform and along the 3300-ft platform to the machines.

Operators of these roving ice machines must be able to communicate continuously with supervisors and workmen at the ice house, control tower and other places along the route to insure an evenly integrated operation as well as to prevent a piling up of ice at any point, when a stoppage or hold-up of operation occurs. Improperly controlled stoppage of the ice delivery can, in a matter of seconds, cause a formidable ice jam which is difficult to clear and creates costly delay.



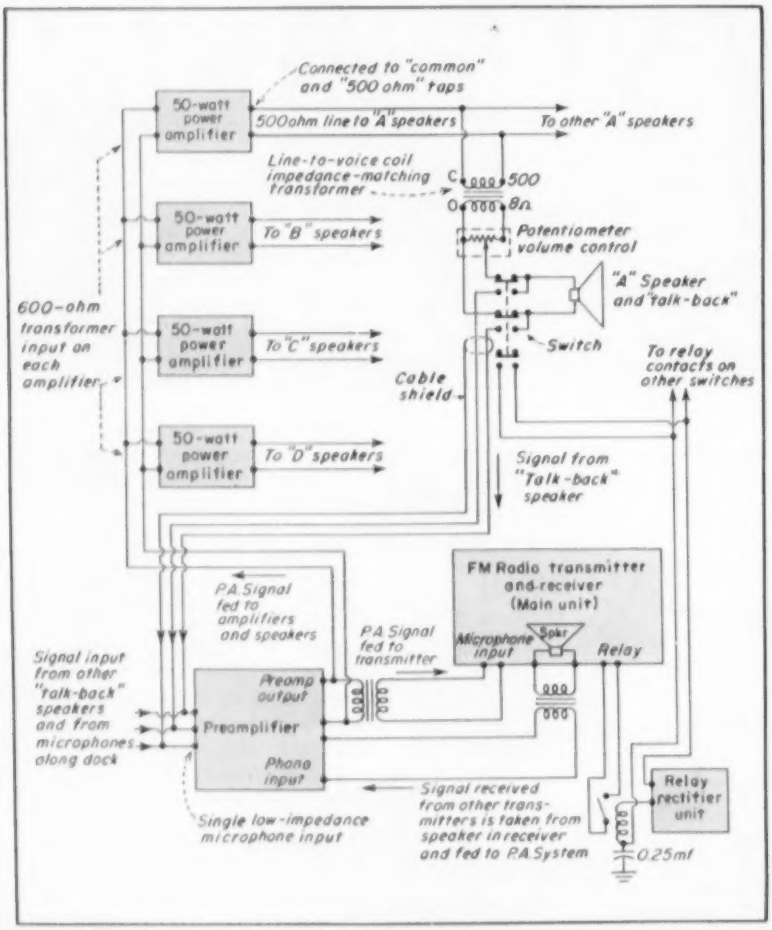
BLOCK DIAGRAM of radio and paging-announce sound system shows basic elements and their interconnection. Only one loudspeaker hookup is shown. Hookup of other speakers is same. Two-way radio communication among four FM units is tied into sound system.

Pacific Fruit Express Company thought the problem of providing adequate communications might be solved by using a short wave radio system. They brought the problem to Hannon Engineering, Inc., Los Angeles, Calif., electrical contractors who specialize in sound systems. Several alternative methods of transmission were considered and rejected in favor of the successfully operating system now in use, combining both wired sound and radio shortwave.

The main concern in design of this system was to provide positive communication with the roving ice machines at all times. The installation of a communications trolley, paralleling the power trolley feeding the machines, was considered as a possible method. However, a trolley line would have been expensive; and, because it would be exposed to the weather, it might have proved troublesome at critical

CONTROL TOWER is equipped with talk-back loudspeaker (on wall) with volume control and a microphone feeding into main radio transmitter. Communications are centered in control tower from which supervisor has clear view of rail yard and icing docks and machines.

FOREMAN'S OFFICE below dock at its midpoint has a microphone and volume control station tied into sound system. In addition to the microphone, this office is equipped with a talk-back speaker to enable the foreman to quickly communicate with other locations when necessary.



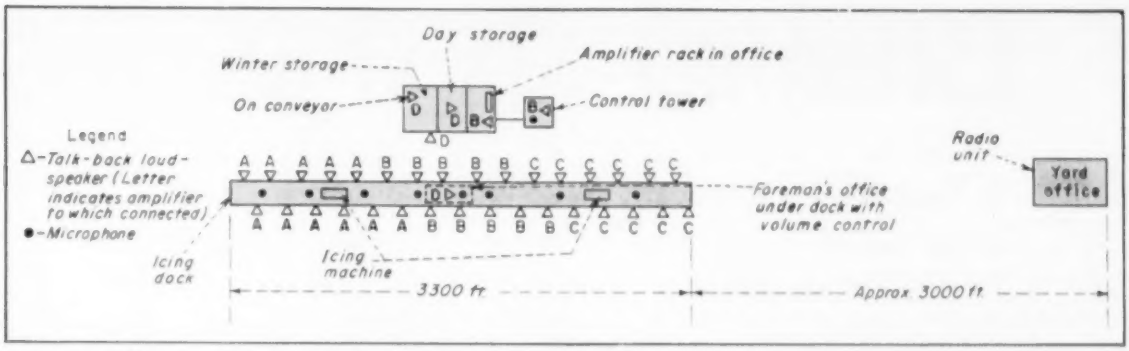
WIRING DIAGRAM shows details of hookup among typical system elements. Relay arrangement puts radio into transmitter operation. System microphones have press-to-talk buttons. Preamp used is actually a 6-watt single-chassis preamp-power amplifier with output taps at voice-coil impedances. Output from this unit is mismatched to load of four 600-ohm input transformers in parallel. Ratio of mismatch reduces 6-watt output to required level to drive power amplifiers.

times. A second alternative method involved the use of a carrier current system operated over the power trolley wires. This plan was discarded because of the possibility of feedback into the main line.

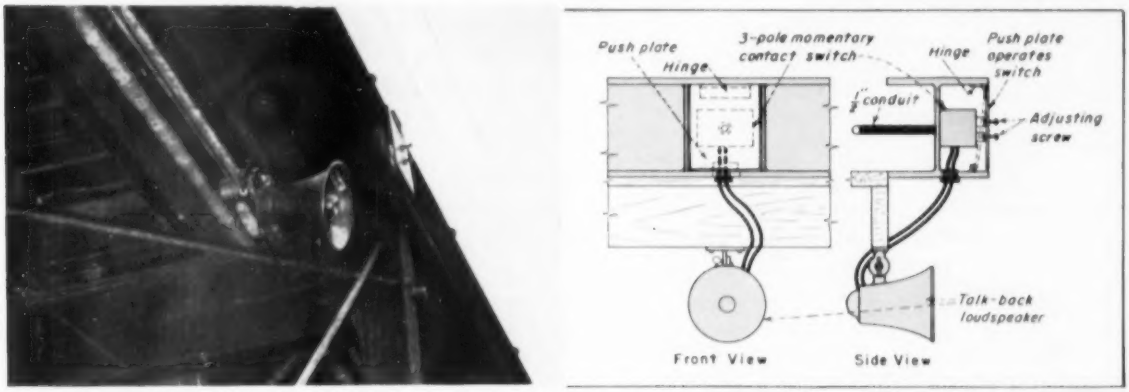
The system finally selected is shown in the accompanying photos and diagrams. The radio system consists of Motorola 154.5-MC-band FM transmitters and receivers. A unit is mounted on each of the icing machines, at the foreman's control tower near the midpoint of the icing dock, and at the yard office about 3000 ft distant, where movement of freight and refrigerator cars are controlled by the railroad.

Spaced at intervals along the icing dock on a wired circuit are seven microphone stations as well as 35 combination microphone and speaker units. This system extends also to the conveyor tunnel beneath the tracks, to the ice-making and storage building and to the control-tower office, where a foreman with a clear view of the entire dock can control the icing operations and give directions to clear up any difficulties.

Communications on the two-way radio system are received at the control tower, amplified and reproduced on all the speakers along the dock. Likewise, any workman along the dock can use one of the seven microphone stations to communicate through all the speakers or to the icing machines and the distant yard office. In the event of an emergency, when quick action is necessary and a workman wants to



PLAN OF YARD shows locations of speakers and other equipment in system.



TALK-BACK SPEAKER is typical of those used along underside of the edge of dock. Hookup of unit corresponds to detail shown in accompanying wiring diagram. With switch in normal position, the loudspeaker operates as a speaker. When push-plate is pressed by hand, speaker will act as a microphone, putting a signal into system.

send a message but is not near one of the microphone stations, any one of the 35 speakers along the dock can be used as a microphone to alert the entire facility.

In the 40,000-ton-capacity refrigerated storeroom where ice is tiered to a height of 60 ft, a microphone is on a cord that can readily be raised and lowered. Thus the sound system can be conveniently operated from any level as ice is stacked up in the wintertime and taken out in the busy summer season to supplement daily production.

Radio communication to the yard office was favored over a wired installation as the direct route parallels a high-voltage line. Installation of a radio-receiver set at the yard office proved more economical than the cost of a lengthy line to circumvent the power line.

In any sound system, if the microphone lines are placed too close to the speaker lines, feedback will result. To avoid this interaction, shielded microphone lines were used. When one of the speaker switches is pushed, it transfers the associated speaker from the speaker line to the input microphone line so that this speaker acts as a microphone. An additional contact on the switch operates a relay in the main transmitter to broadcast the message to the other radio receiver units.

All speakers used in this system are of the weatherproof type for outdoor use and are placed under the dock to protect them from damage. The system is powered by four 50-watt amplifiers.

RADIO UNIT, transmitter and receiver with speaker and microphone is mounted on operating platform of icing machine (arrow). Operator in this photo is standing alongside radio while machine loads crushed ice into ice port on refrigerated car. Power supply to the machine is made via trolley line above machine.

ESTIMATING STREET LIGHTING

A discussion of street lighting installation costs on small jobs where size of projects may not warrant investment in highly mechanized equipment.

By Ray Ashley

Research and Consulting Engineer, Oak Park, Ill.

STREET LIGHTING LABOR COSTS

Small Projects — 10 to 20 Units

Item	Hours Each
Concrete Foundations in Parkway	
20"x20"x30" including bolts	6.5
24"x24"x30" including bolts	8.0
Concrete Foundations in Concrete Walks*	
20"x20"x30" including bolts	8.5
24"x24"x30" including bolts	11.0
Hand Holes — concrete — 18"x18"x24"	9.0
Set and Anchor Lighting Standards	
12-ft. Concrete	7.0
20-ft. Concrete	9.0
20-ft. Steel	7.0
30-ft. Steel	10.0
Wire Standard and Install Luminaire	
12-ft. Standard with Open Reflector	2.0
20-ft. Standard with Enclosed Luminaire	3.5
30-ft. Standard with Enclosed Luminaire on 6-ft. Arm	5.0
Install Mercury Vapor Transformer in Pole Base	2.5
Install Luminaire Lamps	
Open Pole Top Units	0.25
Enclosed Pole Top Units	0.40
Bracket Type Enclosed Units	0.50
	Hours Per Foot
Digging 18"-deep Trenches	
In Parkway**	0.20
In Concrete Sidewalk*	0.60
In Concrete Near Curb*	0.85
Driving 1½" Conduit — curb to curb*	0.90
Installing Cable in Trench	
No. 6 1/C Parkway Cable	0.10
No. 6 2/C Parkway Cable	0.15
No. 6 3/C Parkway Cable	0.22

Notes:
* — Patching Not Included
** — Replacing Sod Not Included

LABOR units based on experience gained from small street lighting projects are good to have. Although labeled for street lighting, they are useful for other work such as yard, court and park lighting projects. This article is confined to small projects because large scale street lighting is a job for a specialist.

The accompanying table of labor units offers substantial values for favorable working conditions, ample equipment and good management. As always, it is the estimator's task to convert the units into terms suitable to the job being figured.

Normal backfilling is included with trenching. If special tamping and wetting down is required, an additional allowance must be made. Replacement of sod is not included. Costs vary according to the type of sod. A good tough sod costs less to handle than a flimsy sod with loose, sandy soil. In general, sod replacement runs from two to five hours per 100 sq ft, depending upon sod condition and care with which replacement is made (wetting, tamping, etc.).

The author often has emphasized the necessity of charging labor to the item occasioning it and not to the item on which it is performed. There are departures from this rule and pulling in street lighting cable is often among them. The standard price is used for installing elbows in foundations and the extra cable-pulling labor occasioned by them is absorbed by the cable-pulling labor units.

Unusual Hazards

Street lighting offers two hazards not likely to be encountered in yard lighting—namely: filled-in land and traffic. The weather may

TRAFFIC OBSTRUCTION results from boom-truck setting lighting standards near curb line. Estimators must provide for man-hours required to slow down and divert traffic around truck at each standard.

also be a greater hazard. Yard lighting work is generally carried along with building construction. In bad weather the men can be shifted to inside work. Street lighting is a job by itself and if rain sets in during the working day, time is lost.

Filled-In Land

In a previous article, hazards of hardpan, rock and loose sand were discussed. Another hazard likely to crop up in street and park lighting is the possibility of the work being done in a section where the land has been filled in. The top soil may range from 6 to 18 in. deep. Below that, there may be rocks, big pieces of concrete, water tanks, automobiles, or any number of other things commonly found in a city dump.

Where soil has been filled in, it is often impossible to push conduit across streets or from post to post. Trenching is also expensive. Patching expenses are increased because there are more openings and wider trenches to permit the removal of obstructions.

Traffic Considerations

One must study the location carefully to learn the possible effects of traffic. Width of sidewalks, width of streets and density of traffic must be considered.

In residential districts, traffic should not be too much of a problem. An exception is apartment house districts, where parked cars may interfere. In business sections, much time can be lost. This is especially true where there is trenching along the curb or where holes have to be cut in streets to remove obstructions for pushing pipe.

Parked cars give street lighting contractors plenty of trouble. Much time is lost while trying to locate owners or arranging to have cars moved. The better equipped contractors have solved the pole setting problem by having trucks equipped with rigging high enough to lift poles over parked cars.

Contractors do as little cutting of streets as possible. It is much cheaper to push in pipe raceways than it is to cut pavement, trench and pay for patching.

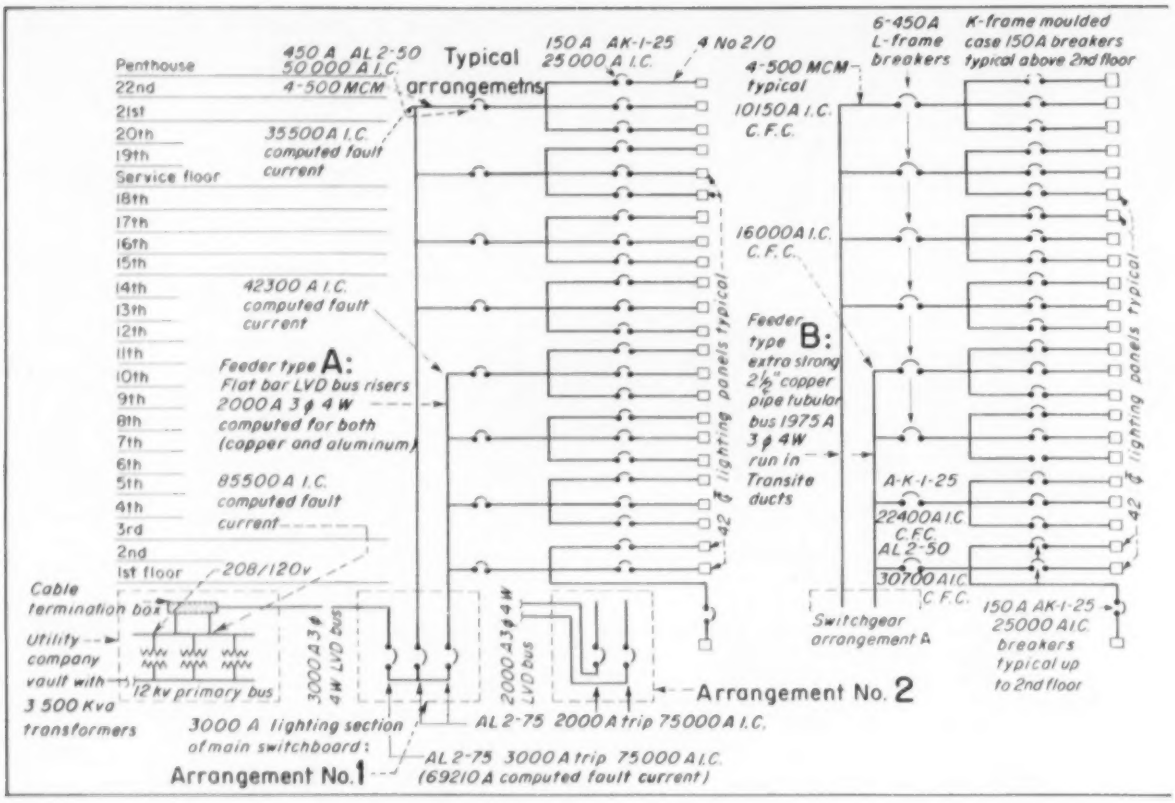
When pushing pipe, it is often necessary to cut holes in the pavement so that obstructions can be removed. Due to the small quantity, the patching costs run high. Most cities and towns have regulations regarding materials and methods, which must be strictly adhered to. In some cases this necessitates buying the concrete mix from a firm authorized to supply it.

In addition to the cost of cutting and patching, there is the expense of putting up barriers and setting out torches. After the concrete has seasoned, another trip must be made to remove the barriers.

No attempt will be made here to give representative costs for cutting and patching pavements because conditions and prices vary greatly. It is better for one not familiar with such costs to get in touch with some local firm engaged in street repair work.

Street lighting jobs have their headaches, but contractors survive them and go back for more. Some have found the work fascinating as well as remunerative. It gives one a chance to use his ingenuity and be resourceful. The number of contractors that continue to do street lighting work, year in and year out, is a good criterion that the work is attractive.

MIDGET BULLDOZER backfills cable trenches in a jiffy, does work of about eight laborers on this residential street lighting project. Unit has rubber treads, is light enough to ride sidewalk without cracking pavement, yet powerful enough to do an effective job.



Engineering and Economic . . . COMPARISON

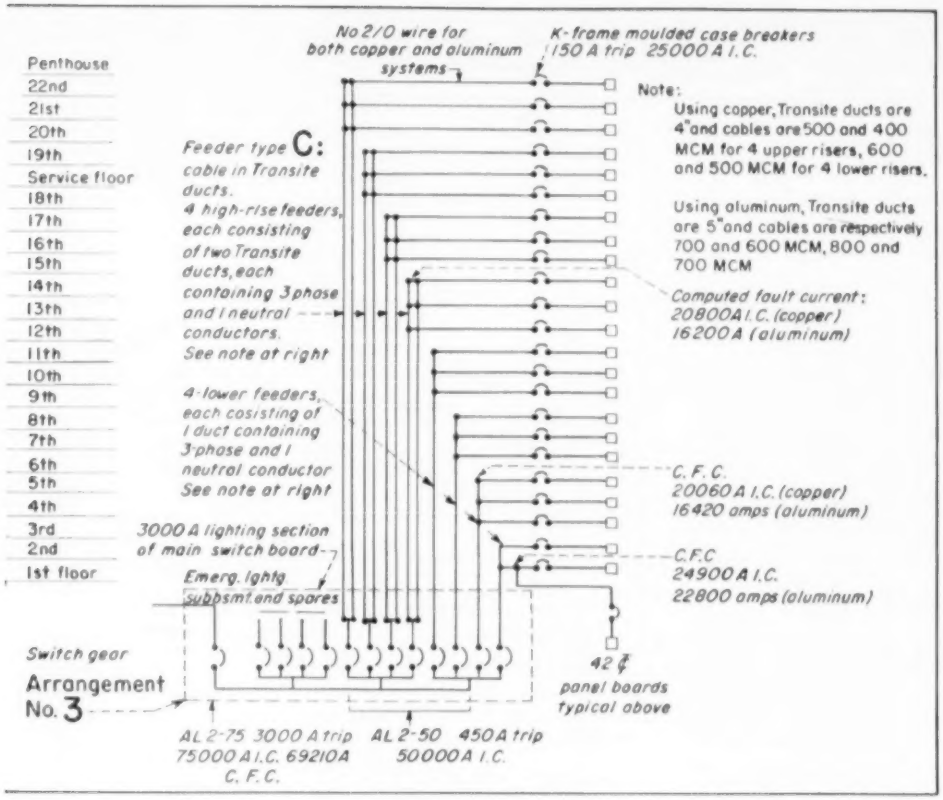
. . . dictated specification and installation of aluminum cables and asbestos-cement ducts in an otherwise all-copper system. Study also considered use of flat-bar and tubular busducts; computing possible fault currents, voltage drops, energy losses, amortization charges and annual operating costs.

By Kenward S. Oliphant,
Chief Engineer for Thomas B. Hunter, Consulting Engineer, San Francisco, Cal.

THE specification of aluminum cable feeders and asbestos-cement ducts for the 22-story addition to Standard Oil of California's headquarters building in San Francisco was based upon an engineering and economic comparison of three basically different riser systems, three different arrangements of main switchgear, and two different distribution metals; i.e., aluminum and copper.

These three elements were variously grouped to form seven possible combinations, and each combination was studied to determine system loadings and capacities in amperes, fault currents and voltage drops at various key points of the systems, circuit breaker requirements under these varying conditions, and energy losses computed on an annual basis.

Comparative costs were then computed for the purchase and installation of switchgear, buses and conductors, supports and fittings,


No 2/0 wire for both copper and aluminum systems
K-frame moulded case breakers 150 A trip 25000 A I.C.
Penthouse
22nd
21st
20th
19th
Service floor
18th
17th
16th
15th
14th
13th
12th
11th
10th
9th
8th
7th
6th
5th
4th
3rd
2nd
1st floor
Feeder type C: cable in Transite ducts. 4 high-rise feeders, each consisting of two Transite ducts, each containing 3 phase and 1 neutral conductors. See note at right
4-lower feeders, each cosisting of 1 duct containing 3 phase and 1 neutral conductor See note at right
3000 A lighting section of main switch board
Emerg. lghtg subsmt and spares
Switch gear Arrangement No. 3
AL 2-75 3000 A trip 75000 A I.C. 69210A C. F. C.
AL 2-50 450A trip 50000A I.C.
42 panel boards typical above
Note:
Using copper, Transite ducts are 4" and cables are 500 and 400 MCM for 4 upper risers, 600 and 500 MCM for 4 lower risers.
Using aluminum, Transite ducts are 5" and cables are respectively 700 and 600 MCM, 800 and 700 MCM
Computed fault current: 20800 A I.C. (copper) 16200 A (aluminum)
C. F. C. 20060 A I.C. (copper) 16420 amps (aluminum)
C.F.C 24900 A I.C. 22800 amps (aluminum)

THREE BASIC TYPES of risers were analyzed during the design stages of this West Coast distribution system. Type A considered the use of flat-bar low-reactance busducts; Type B contemplated tubular bus, while Type C involved the passage of cables in asbestos-cement ducts. Also compared were three different switchgear in the lighting section of the main switchboard; arrangements of 1 and 3 including the use of a main 3000-amp breaker, 2 involving dual bus feeders, 1 and 2 considering only two feeder breakers, while 3 considered a larger number of lower-rated units. Comparisons included both copper and aluminum distribution mediums.

OF SEVEN FEEDER SYSTEMS

connectors and taps. These labor, material, overhead and profit figures were then reduced to annual carrying charges (based upon a 20-year amortization at a 4% interest rate), and these annual equipment charges were added to utility charges related to energy losses within the various systems. Resultant costs varied by 35%, with the economic advantage going to the system which was specified.

Three Riser Systems

The three riser systems which were considered included (1) low-reactance flat-bar busduct, (2) tubular bus—i.e., pipe—carried in asbestos-cement ducts, and (3) insulated cables in asbestos-cement ducts. For reference purposes we will subsequently refer to these three basic riser systems as Feeder Types A, B and C.

As indicated in the accompanying riser diagrams, Feeder Types

Several years ago (November, 1952) EC&M discussed an electrical installation (a 22-story addition to the San Francisco headquarters of Standard Oil of California) in which lightweight aluminum feeders were incorporated into an otherwise all-copper system (refer to "Aluminum plus Copper for Distribution"). In that instance feeders were of hard-drawn stranded aluminum with Neoprene-sheathed RH insulation, connected to copper switchgear through cadmium-plated solderless lugs, and conveyed upwards through riser shafts in Transite ducts. Although differential current-carrying capacities of aluminum and copper dictated the selection of larger feeder sizes, these larger diameters were more than offset by the weight factor, and weight reductions up to 35% were realized.

Reader-interest in that article was high: comments and questions being received pertaining to cost comparisons of other types of systems, fault currents, capacity requirements of related switchgear, voltage drop, energy losses in kilowatts and dollars, and specific amortization charges.

Consultant Thomas Hunter (since deceased) was therefore requested by the Editors of EC&M to discuss further his reasons for selecting aluminum cable risers, and subsequent conversations with the author of this article revealed that the original recommendation had been based upon extensive engineering-economic comparisons between both copper and aluminum busduct, tubular copper, plus both copper and aluminum cables carried in non-metallic ducts. That original study (conducted in 1949) has since beeen revised by Mr. Oliphant to conform with 1956 labor and materials cost data, and this up-to-date analysis is presented herein.

In presenting this material, EC&M wishes to point out that the comparison pertains to loadings and local conditions in a single building; conditions which are not necessarily existent in all types of commercial structures.

Editor

	Low-Reactance Busduct System		Tubular Bus in Transite Duct	Insulated Cables in Transite Duct	
	Copper	Aluminum	Copper	Copper	Aluminum
Total loading in kw	1200	1200	1200	1200	1200
Number of risers	2	2	2	8	8
Loading per riser in kw	600	600	600	150	150
Total loading in amps	3310	3310	3310	3310	3310
Rated capacity of system in amps	4000	4000	3950	4720	4734
Voltage drop at 10th fl.	3.45	3.54	11.25	6.70	6.80
Voltage drop at 21st fl.	7.05	7.31	19.50	6.50	6.52
Total energy losses in kw	23.96	26.80	13.40	10.40	12.20
Annual energy losses in kwh	65120	72600	36410	28400	33100

TABLE I—Engineering comparison indicates wide variations between voltage drops and energy losses related to the several systems under consideration.

A and B are similar in that they each consist of two feeders, one serving the basement plus floors 1 to 11; the other serving floors 12 to 22. Four primary taps are taken off each feeder; each tap provided with overcurrent protection in the form of a 450-amp air circuit breaker cascading to three backup 150-amp breakers related to individual floors.

Feeder Types A and B differ, however, in that Type A risers consist of LVD 3-phase 4-wire busducts rated for 2000 amps each (using either copper or aluminum bars), while Type B risers are formed by arranging 2½-in. extra-strong copper pipe into a 3-phase 4-wire tubular-bus system having the comparable capacity of 1975 amps.

Feeder Type C is considerably different in basic design, for although breakers for all floors are specified to trip at 150 amps (as was the case for Feeder Types A and B), they are not arranged in cascade, and a separate riser is installed to serve each three floors, resulting in a total of eight risers rather than two. As noted, each of the four lower risers carries four cables within a single Transite duct (one cable for each phase and one for the neutral), while each of the four upper risers consists of parallel conductors, that is, two cables per phase and two neutrals, equally distributed between two ducts. As was the case in considering Feeder Type A, this third arrangement was also computed for copper as well as for aluminum cables.

Using copper, the four lower single-duct risers were computed to require three 600- and one 500-MCM cables, while the required diameter of the Transite duct was determined to be 4 in. For the four upper risers, the number of cables were doubled and divided equally between two 4-in. ducts, but sizes of cables were reduced to 500- and 400-MCM.

Using aluminum, both cable and duct sizes had to be increased due to the reduced current-carrying capacity of this medium; the corresponding cable sizes now being 800- and 700MCM for the low rise, 700- and 600MCM for the high rise, with duct diameter increased to 5 in.

By including more copper or aluminum in the four upper risers, the voltage drop in these longer feeders was brought into line with the drops of the four lower risers. This minimization of voltage drop was also furthered through the use of asbestos-cement ducts as the enclosing medium.

In all of these comparisons, individual floor panelboards were designed with capacities for 150 amps, connected to their related cascade breakers or risers (as the case might be) with four 2/0 cables (for copper and aluminum systems alike). Floor loadings were computed by considering total floor area of 7500 sq ft; with 6 watts per sq ft for lighting over approximately 5500 sq ft of office space (33-kw), 2 w/sf in office space for power receptacles (11-kw) and 2 w/sf for 2000 sq ft occupied by stairways, corridors and service areas (4-kw); a total floor loading of approximately 48-kw. Actually, the panelboards selected provide for capacities of 50-kw or 7½w/sf; allowing a 12% growth factor for future expansion.

Three Switchgear Arrangements

In the basement, the three switchgear arrangements that were considered included (1) a single 3000-amp 3-phase 4-wire low-reactance busduct run between the utility transformer vault and the lighting section of the main switchboard, entering the board through a 3000-amp breaker, then serving the two risers (referred to in discussing Feeder Types A and B) through two 2000-amp breakers, (2) two parallel 2000-amp LVD busducts connecting directly to the two riser breakers, and (3) a single 3000-amp incoming bus and breaker, plus 12 feeder breakers rated to trip at 450 amps. Eight of these feeder breakers are related to the eight risers mentioned in discussing Feeder Type C, while the remaining four breakers are related to emergency lighting, spare circuits and 208-volt power requirements such as elevator motors, pumps, ventilation equipment, air conditioning units and similar loads not included in our comparative analysis of distribution systems specifically related to normal lighting.

In all instances the equipment in the utility vault remained the same; three 500-kva transformers stepping 12-kv primarily current to wye-connected 120/208-volts for secondary distribution and utilization, bus structures common to all three units, and a cable-bus termination box related to the 47-ft LVD

Riser System	LVD Busduct				Tubular Bus		Cables in Transite			
Switchgear Arrangement	1		2		1	2	3			
Conductors	Copper			Alum	Copper				Aluminum	
Date of Study	1949	1955	1949	1955	1949	1949	1949	1955	1949	1955
Main Switchboard	$18900	$29960	$15316	$29960	$18900	$15316	$16800	$26990	$16800	$26990
Feeder Distribution	$18256	$23095	$18256	$23095	$7740	$7740	$5520	$9270	$5520	$9270
Bus Connection from Vault	$4800	$9285	$5200	$9285	$4800	$5200	$4800	$5200	$4800	$5200
Conduit, Fittings and Supports	$342	$610	$371	$610	$1231	$1260	$5318	$6640	$5318	$6640
Conductors, Taps and Connectors	$18548	$35996	$18546	$32578	$16469	$16469	$15058	$27474	$11590	$20473
Total Cost of Materials	$60846	$98946	$56691	$95528	$49140	$49985	$47496	$75574	$44028	$68573
Installational Cost	$15481	$19530	$14731	$19530	$17933	$17550	$18214	$22800	$17720	$21960
Total Initial Cost of System	$76327	$118476	$71422	$115058	$67073	$63535	$65710	$98374	$61748	$90533

Notes: Feeder Distribution includes all circuit breakers external to main switchboard.
Installational Cost includes Overhead and Profit.
Switchgear Arrangements 1, 2 and 3 are discussed in detail in the accompanying article.

TABLE II—Costs related to purchase and installation of switchgear, buses, conductors and associated fittings favor the specification of aluminum cables in this specific instance.

busduct link between vault and main switchboard.

Considerable attention was devoted to the possible development of fault currents, including those which might be delivered by motors within the building to the power section of the switchboard, from there into the 300-amp lighting section of the board, and so on to all related switchgear. Under all case-study conditions, this fault current potential at the utility vault secondary bus junction point was computed to be 85,500 amps I.C., while the CFC (computed fault current) at the lighting switchboard's main breaker was found to be 69,210 amps. This dictated the specification of a main air breaker (AL-2-75) having 3000-amp overload tripping limitations and having a 75,000-amp short-circuit interrupting capacity.

At all points above the basement level, however, CFCs varied with the type of feeder system being considered. For example, with flat-bar LVD bus risers (Feeder Type A—considering either copper or aluminum), the CFC at the top of the low riser was found to be 42,300 amps and, at the top of the high riser, it was 35,500. Similarly, in considering Feeder Type B (estimated for copper only), the CFCs at these same two points were respectively 16,000 and 10,150 amps. Using Feeder Type C, CFCs at the first, fifth and fourteenth floors were found to be 24,900; 20,060 and 20,800 amps when using copper cables, and 22,800; 16,420 and 16,200 amps when using aluminum.

Interrupting Capacities

These possible fault currents indicated necessary interrupting-capacity requirements of circuit breakers at different floor levels, and breaker ratings were therefore specified to satisfy these requirements. As a result (and because molded case breakers had limited ratings in 1949, when our initial study was made), cascade breakers for Feeder Type A (flat-bar buses) were specified to be AL-2-50s having ICs of 50,000 amps.

With Feeder Type B (tubular copper buses), possible fault currents dictated the use of an AL-2-50 for the lowest cascade breaker and an AK-1-25 (25,000 amps I.C.) for the next higher cascade unit although, above this point, molded case L-frame breakers were considered to be adequate and sufficient.

It might be pointed out that this decision was considered feasible because (due to spacing requirements for proper mounting of tubular-bus supports and insulators, with corresponding changes in reactance and current-limiting characteristics) fault currents in this area were computed to be below 16,000 amps. And, for the same reason, it was considered to be unnecessary to coordinate these molded case units with related air circuit breakers.

The determination of all other CFCs (indicated on the accompanying riser diagram) and the specification of all other breakers was based upon similar lines of deduction; plus such other pertinent factors as, for example, the variations in conductor center spacing within the ducts mentioned in connection with copper and aluminum cables used for Feeder Type C.

In our study (as recorded in Table I) we assumed a loading of 50-kw per floor. That indicated a total loading on each system of 1200-kw, placing a load of 600-kw on each of the two risers in Feeder Types A and B, and making the riser loading 150-kv for Type C, where eight feeders are considered. In all cases the system loading in

Riser System	LVD Busduct			Tubular	Cables in Transite			
Switchgear Arrangement	1				3			
Conductors	Copper		Aluminum	Copper			Aluminum	
Date of Study	1949	1955	1955	1949	1949	1955	1949	1955
Total Initial Cost of System	$76327	$118476	$115058	$67073	$65710	$98374	$61748	$90533
Annual Cost for Amortization	$5617.67	$8718.83	$8468.33	$4936.57	$4836.26	$7238.34	$4546.53	$6663.23
Annual Cost of Energy Losses	$642	$785	$880	$359	$280	$342	$325	$399
Total Annual Cost of Systems	$6259.67	$9503.83	$9348.33	$5295.57	$5116.26	$7580.34	$4871.53	$7062.23
Total Costs for 20-Year Period	$125193	$190076	$186966	$105911	$102325	$151606	$97430	$141244
1949 Comparison Based on Use of Aluminum Cables	128%			108.8%	105.2%		100%	
1955 Comparison Based on Use of Aluminum Cables		134.9%	132.5%			107.2%		100%

Notes: Switchgear Arrangement 2 was omitted from final comparison due to utility company's preference for Arrangements 1 and 3.
Annual Cost for Amortization is on the basis of a 20-year period at 4% ininterest rate.
Tubular Bus system was not included in 1955 study due to excessively high voltage drop.

TABLE III—Amortization and operating charges also indicate economic benefits related to aluminum cables. This analytical study provided authority for the subsequent specification.

amperes was considered to be 3,310; safely within the capacities of the LVD busduct systems considered as Type A (4000 amps), the copper tubular bus considered as Type B (3950 amps), the copper cable system designated as Type C (4720 amps), and the aluminum cable system, also in Type C (4734 amps). As noted, this last system has the highest current-carrying capacity rating.

In computing line-to-line or phase-to-phase voltage drop, we found that the smallest losses were quite-naturally associated with the LVD (low voltage drop) busduct risers; the drops at the 10th and 21st floors being 3.45 and 7.05 volts respectively. Using copper cables in Transite, these values became 6.7 and 6.5 volts. With aluminum in asbestos-cement enclosures the values were found to be 6.8 and 6.52-v. And, with the copper tubular bus system, the corresponding drops increased to 11.25 and 19.5-v. These latter values were considered to be excessively high and, for that reason, the system received scant consideration as a comparative alternative.

Using these same voltage-drop and floor-loading values, we then determined the energy losses (in kilowatts) related to each system and, by assuming an in-use factor of 52¼ hours per week (9½ hr/day 5½ days/wk) we estimated the respective annual energy losses which are also indicated in Table I.

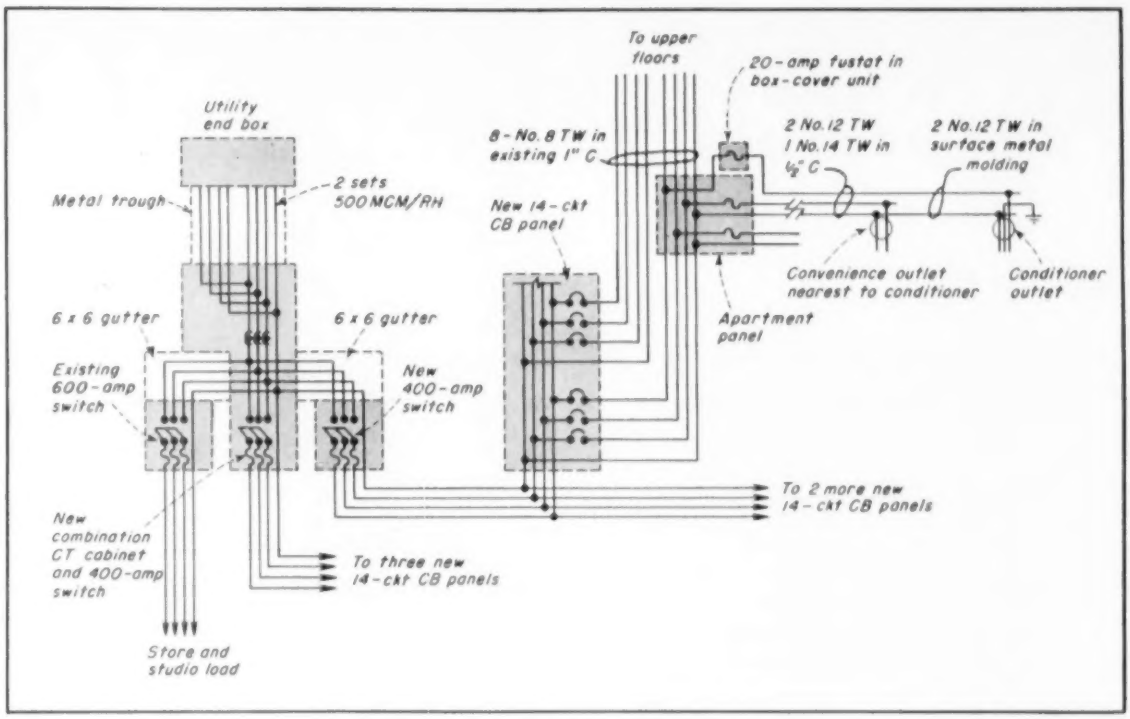
Comparison of Costs

Costs related to the purchase and installation of switchgear, buses, conduits and the like (Table II) showed that (in 1949 when the initial study was made) aluminum cable in Transite was the least expensive of the various systems considered; its installed cost being $61,748. When the study was brought up to date in 1955, aluminum in Transite was still the least expensive to install; the margin being even wider percentagewise even although costs had risen.

In referring to Table II it will be noted that Switchgear Arrangement 2 and Riser Type B were omitted from the study in 1955. This was due to the fact that the utility company did not favor the installation of parallel busduct connections between the transformer vault and the main switchgear (with the conjunctional omission of a main 3000-amp switchboard breaker), and copper tubular bus (as mentioned previously) had voltage drops which were considered to be excessive. Incidentally, it can also be mentioned that cost estimates for both copper and aluminum cable riser systems contemplated the use of premium quality 75-degree RH cables with oil-base insulation sheathed with heavy Neoprene multaneously vulcanized in a continuous mold.

The final step in our economic comparison combined installation costs with charges related to the various energy losses; totals being figured on both an annual and a 20-year-amortization-period basis. These conclusions (Table III) again indicated that aluminum cable in asbestos cement ducts were the most economical, by both 1949 and 1955 comparisons. In fact, by taking this system (Type C Feeders and Switchgear Arrangement 3) as a comparative base (i.e., 100%), it may be noted that the other systems would have been from 5-to-28% more expensive by 1949 costs, and from 7-to-35% greater by 1955 values.

As a result of this engineering and economic analysis, the recommended system was installed (by electrical contractor Fay Lemoge of San Francisco), and the intervening years of actual use have closely verified the accuracy of our predicted costs, charges and operational characteristics.


To upper floors
20-amp fustat in box-cover unit
Utility end box
8-No. 8 TW in existing 1" C
2 No. 12 TW 1 No. 14 TW in ½" C
2 No. 12 TW in surface metal molding
Metal trough
2 sets 500MCM/RH
New 14-ckt CB panel
Convenience outlet nearest to conditioner
Conditioner outlet
6 x 6 gutter
6 x 6 gutter
Apartment panel
Existing 600-amp switch
New 400-amp switch
To 2 more new 14-ckt CB panels
New combination CT cabinet and 400-amp switch
To three new 14-ckt CB panels
Store and studio load

Apartment House Doubles Capacity

USING EXISTING CONDUIT RISERS

A MANHATTAN apartment building rewired by G. S. Electric Co., New York City, illustrates how a minimum expenditure can double existing capacity to provide for air conditioning and alleviate dangerous overload conditions.

The 18-floor building, containing 82 apartments, two penthouses and four stores, was served previously through a 4-wire, 600-amp service switch and a 30-circuit fused distribution panel. Risers to individual metered apartments were 2-wire, No. 12 R in 1-in. conduit.

Rewiring without replacing the existing concrete-embedded rigid conduit risers was possible only because the risers had been maintained at 1-in. all the way to the upper floors. Using eight No. 8 TW conductors per riser, it was possible to increase the safe carrying capacity to the average apartment from 16 amps to 32 amps.

In the basement, two new 400-amp service switches were installed as shown in the diagram, one being a combination switch and current transformer cabinet. Existing apartment meters were disconnected and removed, leaving only those metering the stores. The existing 500MCM feed from the utility end box to the old 600-amp switch was diverted to one 400-amp switch as shown, new connection between a new larger end box and the CT cabinet being accomplished by pulling in two 500MCM RH cables in metal trough. The old 600-amp switch was retained as feed for the store load, which was not disturbed; each 400-amp switch feeds three new 14-circuit distribution panels.

Special receptacles were installed for ¾-ton air conditioners where desired, either in the bedroom or living room of the apartments. This was accomplished by extending the nearest existing wall receptacle outlet by means of surface metal molding. The old 2-wire No. 14 feed was pulled out and replaced by two No. 12 TW and one No. 14 TW, one No. 12 serving as neutral for both circuits. The conditioner circuit was fused at the apartment panel with a 20-amp fustat in a box cover unit mounted on the panel.

While it was recognized that this capacity increase left something to be desired, the foreseeable return on the investment required for completely new risers would have been inadequate to make it financially possible. The owners, seeing a constant growth in neighborhood standards, believe such complete rewiring may be feasible five to ten years from now along with structural improvements.

Total cost of modernization to the building owner averaged $170 per apartment. The tenants are being assessed $75 for addition of the air conditioning circuit, and rental procedure has been revised to include a flat rate for electrical power.

ELECTRICAL DESIGN TRENDS

. . . in American Skyscrapers

Higher primary and secondary currents, use of reactors to limit interrupting capacities of switchgear, utility transformers serving a common secondary bus structure, draw-out service-entrance breakers, bus-duct feeders to distribution points, use of underfloor ducts and Q-flooring, circuit-breaker lighting panels, lighting at 265-volts and minimum illumination levels of 50 footcandles. These are some of the significant trends being adopted for electrical systems serving modern commercial skyscrapers.

By Harry C. MacNary,
Vice-President, Fischbach and Moore, Incorporated, New York, N. Y.

NIGHT VIEW of Lever House in New York City emphasizes trend towards uniform high-level illumination throughout modern commercial buildings.

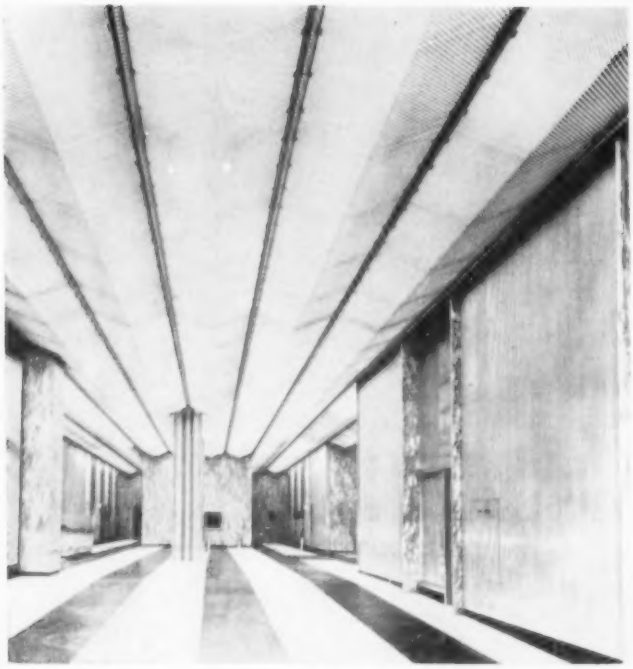
ELECTRICAL installations in multi-story commercial buildings can vary widely in scope and complexity, depending upon type of ownership as well as upon ultimate use or purpose of the structure. For example, owner-occupied buildings such as Alcoa and Lever House can have layouts which are elaborate and costly. Many governmental and first class speculative buildings also can be rated as somewhat above average in design. This latter group would include such buildings as the 40-floor U. N. Secretariat and the still-under-construction 42-floor Socony-Mobil building, both in New York City. Considered together, these two buildings could well serve as the basis for analyzing present-day skyscraper standards and trends, for the Secretariat has a fundamental distribution system for 208/120-volt current, whereas the Socony building distributes power at 460/265.

Trend to Higher Voltages

The trend towards distribution at 460/265-volts, rather than at 208/120, has been dictated primarily by rapid electrical growth in metropolitan commercial buildings. This growth, which has boosted some building loads by over 300% in a quarter century, can be effectively illustrated by considering the Empire State Building which was originally designed in 1931 for a load of 7800-kva, was increased in 1949 to 16,800-kva, then had to be increased again in 1954 to 25,-800-kva to keep pace with increasing tenant-demand electrical services.

These growth patterns prompted utility companies and consulting engineers to reconsider and revalue formerly-accepted distribution concepts, with the result that present thinking believes that 460/265-volt distribution is advantageous whenever a building's demand exceeds 2000-kva.

This switch does not involve untried techniques. On the contrary, it makes effective use of sound engineering principles; the soundness of which can be demonstrated particularly effectively by provisions for adequate interrupting capacity, from entrance stubs to lighting



MAIN LOBBY of Alcoa Building in Pittsburgh typifies trend towards comment-provoking lighting treatments in areas most-commonly viewed and appraised by the public. Here lighting is provided by closely-spaced cold-cathode lamps shielded by suspended grillework of woven aluminum rods backed by plexiglas. Intensities can be varied via dimmers.

UNITED NATIONS headquarters has numerous assembly halls where decorative and functional lighting treatments are combined, such as in the Economic and Social Council Chamber where illumination is obtained by a combination of cold-cathode indirectly-lighted coffers and recessed incandescent downlights.

panelboards and ends of distribution lines.

Short circuit current for equal kva is, of course, less at 460 volts than at 208. However, in the network of the utility company serving New York City (Consolidated Edison), short circuit duty on utility buses can approach 200,000 amps 3-phase at 460 volts.

To meet such a requirement, two basic engineering approaches may be followed. One: all equipment can be rated 200,000 amps interrupting capacity. Or two: current may be limited to 100,000 amps just after it enters the building, thereby permitting the use of 100,000 amp IC equipment.

The use of 200,000 IC equipment presents certain problems, such as the high cost of the equipment itself (entrance breakers, busway and power panelboards), and the non-availability of standard-design equipment in this capacity range. For these reasons, placing an IC limit of 100,000 amps on the system, and reducing short-circuit duty through the use of reactors, is considered to be the most effective and economical system. This was the system chosen for the Socony-Mobil building.

Insured Distribution for the United Nations

The mammoth U. N. Secretariat (500 ft high, covering six city blocks) has six primary feeders at 13.8-kv and four secondary feeders at 208/120-volt 3-phase 4-wire. To insure service continuity, all feeders are from separate sections of the utility distribution system; they enter the building from two different property lines, and building services are supplied from two different terminals (1st basement and 28th floor).

As additional insurance against complete power outage, the building has two separate riser shafts, both split at the 17th floor to effectively quarter the distribution arrangement. Distribution is further segregated into separate categories of power, plus normal and emergency lighting, and the power system is still further subdivided into sections for elevators, escalators and mechanical equipment. These power requirements are sizable, for the combined load of elevators and escalators alone amounts to 1444 hp, while fans, pumps, air conditioning and miscellaneous equipment boosts this total materially.

Of special interest is the fact that the 1st-basement and 28th-floor service points are connected via ten conduit runs (containing four primarily feeders, four second-

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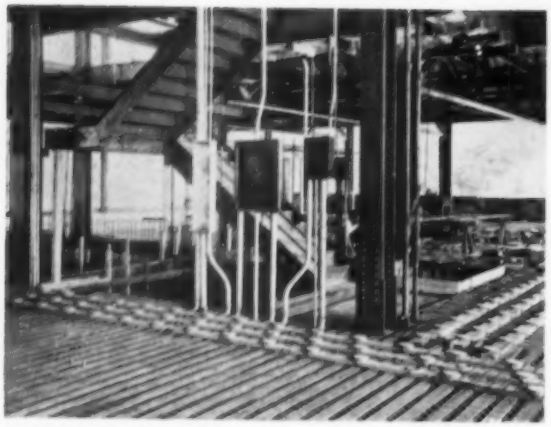
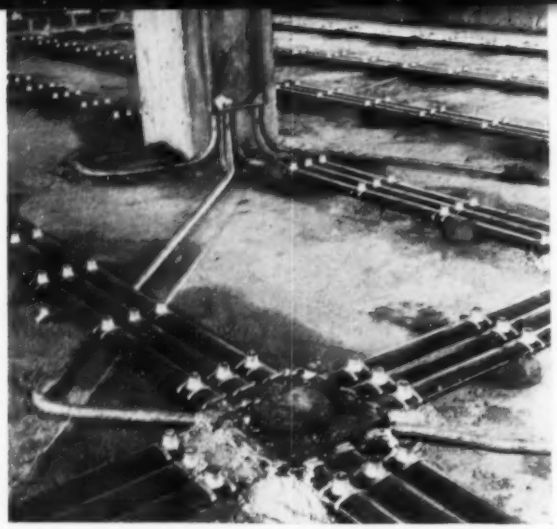
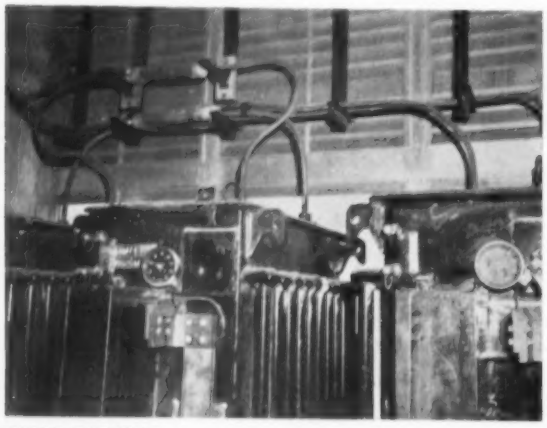
Earlier this year, author MacNary had the honor of addressing the Association of Supervising Electrical Engineers at the Royal Institution of Great Britain in London. In his analysis of comparative engineering approaches related to "Electrical Installations in American Multi-story Buildings", he included extensive references to distribution systems in such skyscrapers as the 40-floor U. N. Secretariat, the still-in-progress 42-floor Socony-Mobil building, the 30-floor Alcoa aluminum building in Pittsburgh (EC&M, May 1952) and several other outstanding multi-story buildings likewise wired by Fischbach and Moore. While space precludes an extensive review of his paper, we believe the following abbreviated comments and conclusions should be interesting to all who are concerned with power distribution in tall commercial buildings.

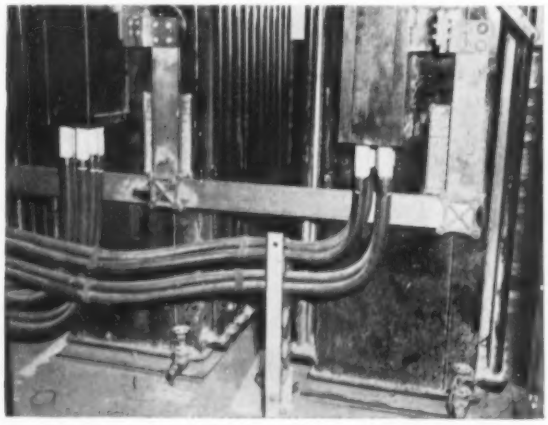
Editor





SECONDARY DISTRIBUTION in commercial buildings now generally involves use of either cellular structural floor members or multiple-cell underfloor ducts. In Lever House, headers for Q-floors were installed just prior to the pouring of concrete (left), thereby minimizing possibility of damaging these components. At Secretariat (right), junction boxes for underfloor duct system were grouted in place, although subsequently-adopted practice is to use powder-activated stud guns to secure JBs to rough slabs.





CABLE RACKING, means for supporting feeders, proper splicing methods and accurate identification are all indications of conscientious workmanship and attention to details. This is evident at U. N. Building, where gas-tested 13.8-kv primaries (left) and 208-volt secondaries (right) are connected in approved manner to 333-kva transformers.

ary feeders and two spares). Feeders contained in these conduit runs are of unique design, each consisting of three No. 1 AWG stranded concentric rubber-covered cables, first shielded separately by tin-copper tape, then armored collectively by No. 8 AWG galvanized steel. These cables, each measuring 350 ft overall and weighing 2300 pounds, are supported at the 28th floor only, clamps being secured directly to the building's structural steel.

Common Secondary Bus Structure

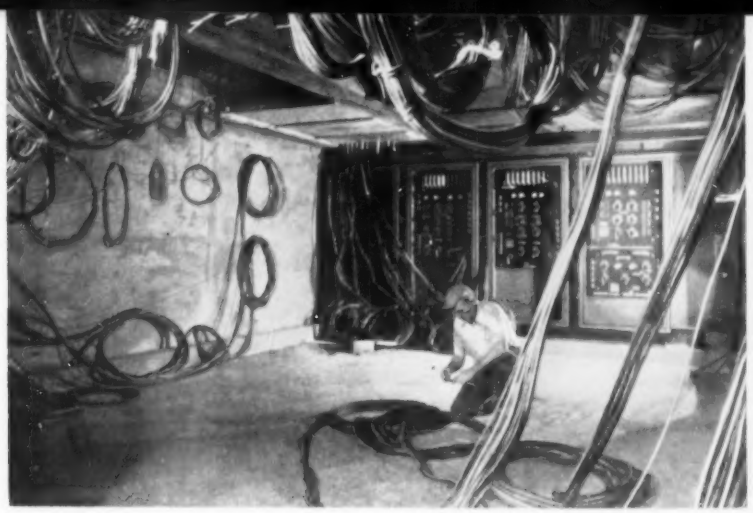
Considering the upper and lower service terminals of the Secretariat collectively, there are ten 1000-kva transformer banks in all; secondaries from all transformers being paralleled to a common secondary bus through network protectors. From this common bus, six 4000-amp 208-volt 3-phase 4-wire take-offs feed various distribution boards.

Each board is equipped with an electrically-operated main circuit breaker (draw-out triple-pole single-throw 4000 amps 600 volts ac with an IC of 100,000 amps) and with manual secondary breakers (ranging in capacity from 600 to 2500 amps with 50,000-amp ICs). Secondary distribution is via low-impedance busways having ratings corresponding to their respective breakers, i.e., between 600 and 2500 amps.

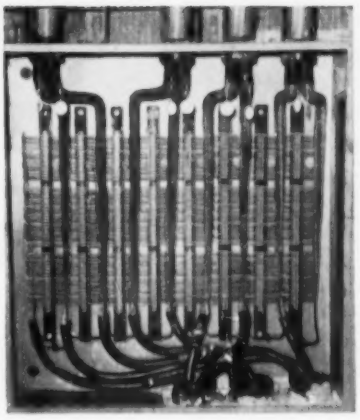
All sectionalized motor control centers have main breakers, silver-plated bus assemblies running laterally through all sections then vertically through all cubicles, and combination drawer-type grounded breakers and across-the-line motor starters having silver-plated stab connectors for establishing contact with the vertical buses.

Lighting Circuits Prevent Total Black-out

Distribution for lighting in the 40-floor Secretariat is through 14 800-amp and one 600-amp breakers and full-neutral busways, seven of which serve floors up to and including the 17th, four more serving floors 18 through 28, and the remaining four serving all floors from the 29th upwards. Busways are divided between two shafts and, below the 17th floor, busways are further divided to serve only



COMPLEXITY and extent of low-voltage wiring is another growing trend in modern commercial structures. This is effectively indicated by the installation picture taken in the Security Room of the U. N. headquarters, where constantly-supervised closed-circuit low-voltage systems are related to fire and sprinkler alarms, rate of temperature rise, and watchman tours.



REAR VIEW of fire alarm panel shows extent of circuitry, use of terminal strips, method of grouping and identifying circuits, construction and mounting of cabinets.

one half of every second or third floor. For example, busway No. 3 first rises through the north shaft from the sub-basement to the 17th floor, then feeds downwards to serve the north half only of floors 2, 5, 8, 11, 14 and 17. Other busways vary in detail of routing or service, yet it is evident that failure of a breaker or busway would only partially curtail lighting service under this arrangement.

Current for emergency lighting and stair exits is also distributed through separate multiple feeders, shafts and panels, so that a fault of any single section or device would affect only a small segment of the entire emergency distribution system.

Since all occupied floors of the Secretariat are identical in construction, distribution for all light and incidental power is standardized. This includes a bus-cable tap box for each floor, a main lighting panel and sub panel for floor services.

The lighting system was designed to provide 40 footcandles of initial illumination at desktop level, with a 3-lamp 40-watt eggcrate-louvered flush-mounted fixture lighting each 9-by-7-ft area (approximately). Fixtures are controlled from column-located switches in groups of eight, with flexible conduit connecting four fixtures to a common outlet box, and with either No. 12 or No. 10 wire (depending upon length of branch run) connecting each pair of boxes to the main panel. Wiring is located above suspended snap-in metal acoustical ceiling pans, and each lighting fixture is abutted at each end by an air-conditioning diffusing grille. Since these grilles are also connected flexibly, louvers and fixtures may be shifted slightly to conform with local partition or desk positions. And, since all fixtures, diffusers and ceiling pans were finished with paint from the same manufacturer, the overall ceiling appearance is one of custom-tailored unity.

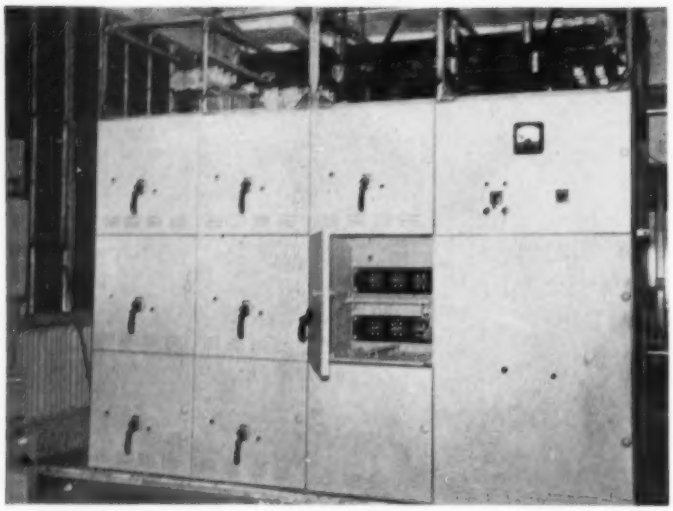
Underfloor distribution in this building is by means of 3-cell fiber duct; one cell related to 120-volt wiring, the second to the telephone system and the third to miscellaneous low-voltage and sound. This latter service is unique in that the low-voltage signal wiring includes provisions for occupants of the building to obtain interpretations of U. N. discussions in any one of five official languages merely by dialing the proper council chamber and the language desired. The underfloor system, incidentally, was the largest in the world at the time of its installation, for the total length of 3-cell ducts amounted to over 44 miles.

PRIMARY FEEDERS connecting basement and 28th-floor service vaults of Secretariat are of special design; each one consisting of three concentric stranded copper cables, separately shielded by tin-copper tape, then collectively encased by galvanized steel armor. Each cable, weighing over a ton, is supported only at its upper terminal; clamps being secured directly to building structural steel. Grounding cables, porcelain insulators and plugs for gas-testing splices are visible in the above photo.

Primary Service at 69-kv

The more-recently-designed completely-air-conditioned Socony-Mobil building (with a total floor area of 1.6-million sq ft), has four 69-kv and two 13.2-kv primary feeders, serving six 2000-kva transformer vaults installed at street level. As in the U. N. Secretariat, all transformer secondaries (460/265-v) are connected to a common secondary bus. However, since no 460/265-volt current is available directly from the utility company's street network, no current at the secondary level comes into the building.

Utility take-offs are protected by 4000-amp silver-sand fuses in each phase leg of the 3-phase 4-wire take-off, then copper is run to a 4000-amp full-capacity reactor (sufficient to reduce the IC from 200,000 to 100,000 amps). Incom-



DISTRIBUTION BOARDS are now predominantly free-standing dead-front units, delivered as disassembled matched components which are assembled in place. Opened branch feeder cubicle shows mounting provisions for manually-operated breaker. Main breaker in cubicle at lower right is electrically-operated 4000-amp unit.

ing service then goes to a 4000-amp draw-out main circuit breaker (as in the U. N. building).

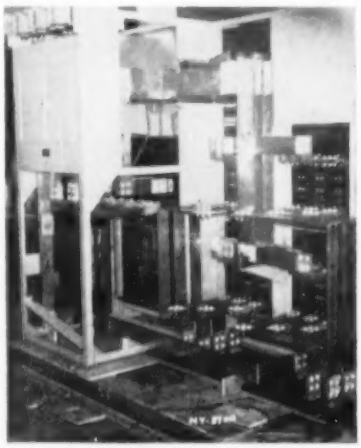
Distribution within the building, from utility take-offs to local distribution and control centers, is by means of ten 4000-amp 3-phase busduct runs; six of them (related to main distribution boards, also owner's power equipment) being 3-wire, and four of them (serving tenants' premises) being 4-wire. Power continuity is insured by utilizing two separate risers, with duplicate electrical closets on each floor serving different areas or duplicate items of power equipment, such as elevators (2523-hp), and heating, ventilation and air-conditioning motors (4910-hp).

Core and stair lighting is furnished at 120 volts by means of four 3-phase 4-wire 2-winding dry-type transformers having 460-volt primaries. These transformers have a total capacity of 600-kva, and secondaries connect through four separate distribution boards to lighting panels on each floor. Tenants' floor panels are likewise served by 3-phase dry-type 208/-120-volt transformers which are specially designed for minimum noise and vibration, and which are installed in electric closets on the various floors.

Secondary Distribution is Influenced by Metering Methods

Metering at the U. N. and Socony-Mobil buildings definitely influences secondary distribution details, inasmuch as the former has a master-meter set-up (with only one billing from the utility company supplying primary service), while the latter building has separate meters for the owner and each individual tenant.

Under this arrangement, a separate energy meter is installed at each of the four take-offs serving the owner, then a single totalizing demand meter registers the coincident demand for the four feeders.



BUS STRUCTURES and control panels of this distribution board were factory fabricated and checked, then assembled on the jobsite by the electrical contractor. Utility service taps are shown at upper left, directly above section where the connection of emergency takeoffs permit by-passing of the main breaker.

Since local regulations limit tenants to only one meter per floor, a tenant occupying only one floor cannot enjoy any diversity of service. However, tenants leasing two or more floors can alternate their take-offs between risers, then can serve their various floors by installing cable-in-conduit runs as they wish.

Lighting at 265 Volts Has Economic Advantages

Let us consider some of the savings that have been made by using a 460/265-volt system (Socony-Mobil) rather than a 208/120-volt system (Secretariat).

First; at the U. N., a maximum of 15 ballasts (8 fixtures) could be installed on a single 120-volt circuit, whereas, at the Socony-Mobil building, we are allowed 30 ballasts (30 fixtures) per circuit.

Second; lighting fixtures for 265 volts cost no more than 120-volt units, and there is quite a saving to be made in circuiting, since the number of fixtures per branch may be doubled.

Third; by using 440- instead of 208-volt motors, feeders may be reduced approximately by half, due to reduced current required.

Fourth; there are considerable savings to be realized in entrance switchgear and risers at the higher voltage level because, with a voltage drop limit of 1%, the permissible drops become 2.08 and 4.8 volts respectively. Therefore, combining reduced current with higher permissible voltage drop, it is possible for a given busway to carry double the kva load (at 460 volts), with less than ½% v.d.

The only major additional cost related to the 460/265-volt system is for dry-type transformers for floor service, and this item is infinitesimal compared with total overall economies.

To summarize, practically all of our recently-completed buildings have draw-out circuit breakers for service entrance switching. They also have busduct feeders (copper or aluminum) from service entrances to distribution points. Also common today are circuit-breaker panels for both floor (power) and ceiling (lighting) use. Underfloor distribution is by means of either multi-cell ducts (fiber or metal) or Q-floor channels. And the general concept for lighting now considers 50 footcandles as the minimum acceptable level.

Case Study in

LOW-VOLTAGE SWITCHING

Whiffen Electric of White Plains, N. Y., installs extensive multi-point, low-voltage switching in a Scarsdale residence using new, independent, transformer-relay devices.

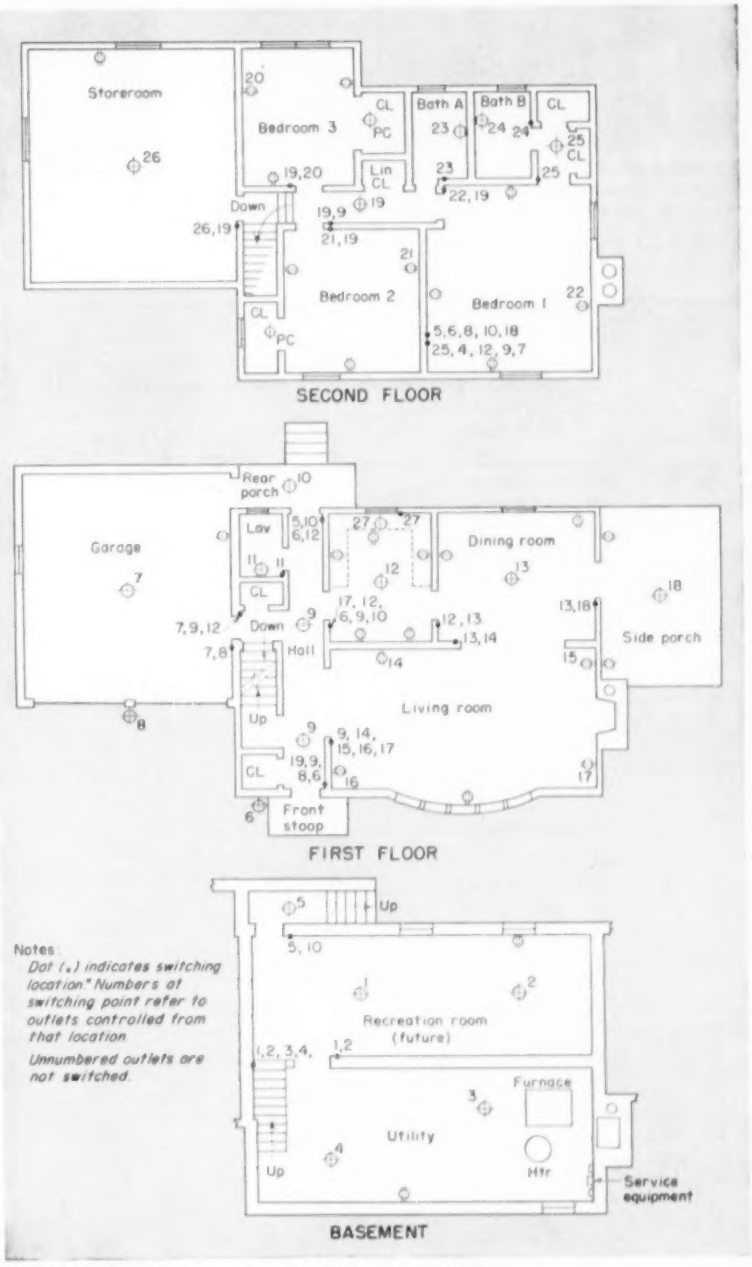
WORKING from a carefully planned switching layout, Whiffen Electric Co., Inc., White Plains, N. Y., has installed a low-voltage, remote-control switching system employing Remcon relays and control switches in a Scarsdale residence. The system provides many unusual features of convenient control applicable to modern residential wiring practice.

Layout principles were exacting: 1) Control should provide an uninterrupted "path of light." 2) Lights in all rooms, halls and stairs, except the bedrooms and baths, should be operable before entering the room as well as from within the room. 3) Control should be functional and "logical." 4) Provisions should be made for "protection" control of outside and selected inside lights from the master bedroom.

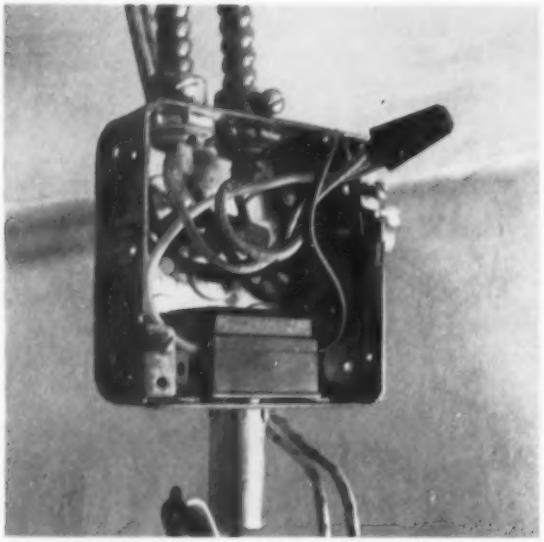
The completed project has 28 controlled outlets with a total of 59 points of control in 23 switch plates.

The accompanying floor plans and table illustrate in detail the diversity of control obtained through the use of the relays and momentary-contact switches.

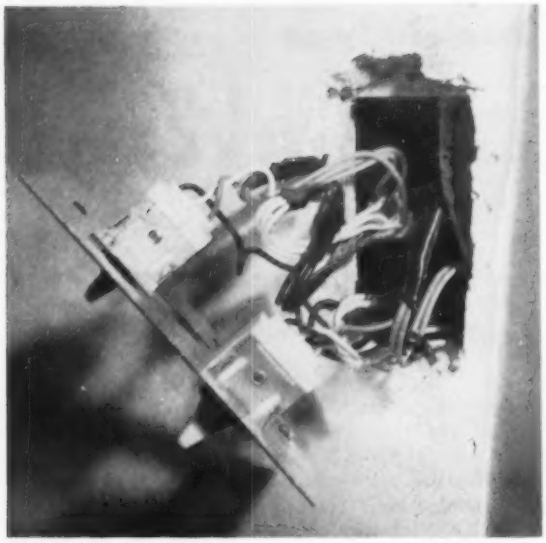
On the first floor, the lights in each room may be controlled from any entrance to the room. The two hall lights (9) are controlled simultaneously from any room entering upon the hall as well as from the front, rear and garage entrances to the house. To assure adequate stairway illumination when descending from the second floor, these hall lights may be switched also from the second floor hallway. The kitchen switch controlling living room receptacle (17) enables the television set to be switched off when the telephone rings, the telephone being located on a kitchen counter. After the phone conversation, the TV may be turned back



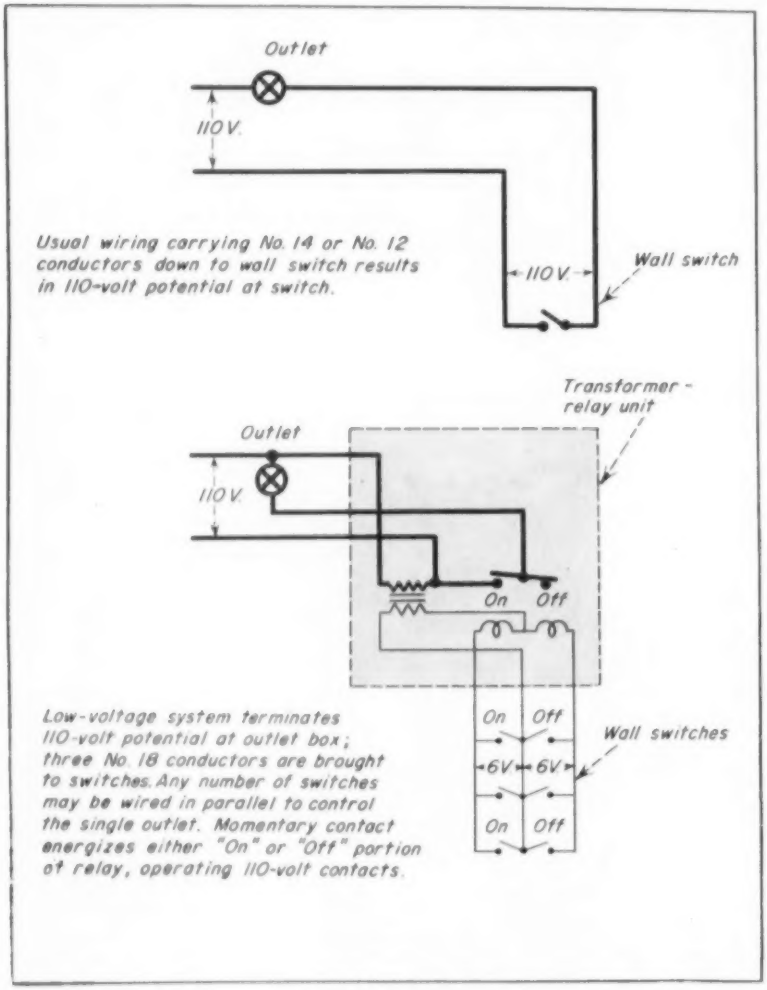
FLOOR PLANS show locations of outlets and switches.



TRANSFORMER-RELAY unit was mounted through box knockout. Line-voltage connections were made within box; low-voltage leads were spliced to control wire outside box.



MOMENTARY-CONTACT wall switches, mounted to metal plates in groups of from one to five, were spliced to 3-conductor control wire. No wall box was necessary.


Outlet
110V.
Usual wiring carrying No. 14 or No. 12 conductors down to wall switch results in 110-volt potential at switch.
110V.
Wall switch
Transformer - relay unit
Outlet
110V.
On
Off
Low-voltage system terminates 110-volt potential at outlet box; three No. 18 conductors are brought to switches. Any number of switches may be wired in parallel to control the single outlet. Momentary contact energizes either "On" or "Off" portion of relay, operating 110-volt contacts.
On
Off
Wall switches
6V
6V
On
Off

on without change in volume, tone or picture adjustment.

Ten switches in the master bedroom provide for control of "protection" lights inside and outside. These include all five lights outside the house, the inside garage light, the downstairs hallway, the basement light at the foot of the stairs, and the kitchen ceiling fluorescent fixture.

The upstairs hallway light (19) may be switched remotely from all three bedrooms, the storeroom (future study or bedroom) and the front entrance downstairs.

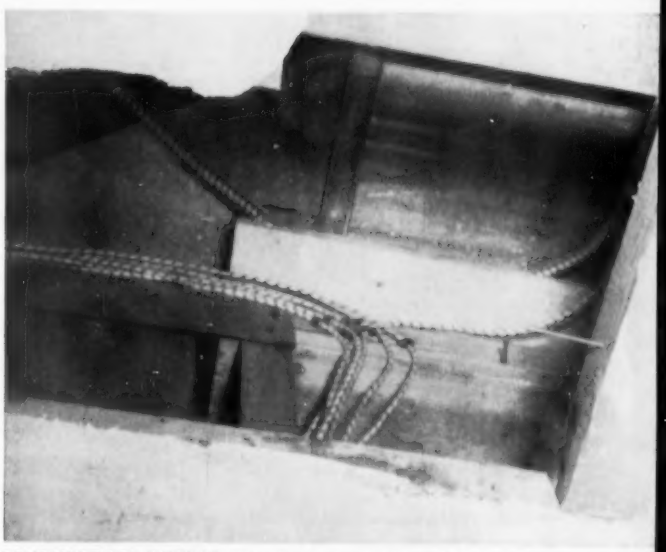
Front and rear exterior entrance lights may be remotely controlled from the kitchen and master bedroom to permit the lights to be switched on promptly upon the ringing of the doorbell by an unexpected guest.

Wiring

To provide for the relay unit, octagonal outlet boxes 2½" deep were used, the relay normally being housed in the box for the outlet controlled. Exceptions were made for the exterior garage light and the lights on the front and rear porches, the fixtures used being too shallow. In these instances, the relay was mounted in the nearest outlet box inside the house.

The 115-volt wiring to fixtures and receptacles was armored cable, installed in the usual manner. The relay unit was inserted through a

MOUNTING PLATES were supplied with standard punching for five switches. Finished wall plates contained only openings for number switches actually installed.



LOW-VOLTAGE WIRING, seen here through opening in ceiling for kitchen cabinets, was fastened to wall framing using insulated staples.

knockout and wired as shown in the accompanying diagram. The control wire used between the relays and switches was stapled directly to studs, rafters, joists and wall plates using standard insulated staples.

Where switches were paralleled, splices were made either at switch terminals or at outlet boxes. Boxes at switch locations were unnecessary; installation consisted of nailing a metal plaster ring support to the wall stud, screwing a metal mounting plate to the support, connecting the switches, and adding the finish switchplate. A single hole drilled through a framing member which would ordinarily accommodate only two non-metallic sheathed cables provided passage for a great number of the smaller thermoplastic conductors used.

Service to the house is rated at 150 amps, using two 1/0 RH and one 1/0 bare conductors. Distribution is by two breaker panels, each containing three 2-pole 220-volt appliance and lighting breakers as mains plus eight single-pole breakers serving lighting and receptacle branch circuits.

Wiring advantages of the system are provided by the momentary-contact switches, making it unnecessary to resort to 3- and 4-way switches, and by the individual transformers, eliminating the need for running a separate wire back to a transformer for each relay.

Outlets and Location of Control Switches

1,2	Basement ceiling lights Head of basement stairway Doorway to recreation room
3	Basement ceiling light Head of basement stairway
4	Basement ceiling light Head of basement stairway Master bedroom
5	Exterior light, basement entrance Basement entrance Rear entrance Master bedroom
6	Exterior light, front stoop Front entrance Kitchen Master bedroom
7	Garage ceiling light Garage Garage entrance to house Master bedroom
8	Exterior light, garage Garage Front entrance Master bedroom
9	Hallway, 1st floor (2 lights) Front entrance Rear entrance Garage entrance to house Kitchen Hallway, second floor Master bedroom Hallway entrance to living room
10	Exterior light, rear porch Rear entrance Basement entrance Kitchen Master bedroom
11	Lavatory light Lavatory
12	Kitchen ceiling, fluorescent Kitchen Rear entrance Garage entrance to house Dining room Master bedroom
13	Dining room chandelier Kitchen entrance to dining room Living room entrance to dining room Side entrance
14	Living room receptacle Hallway entrance to living room Dining room entrance to living room
15,16	Living room receptacles Hallway entrance to living room
17	TV receptacle, living room Hallway entrance to living room Kitchen
18	Exterior light, side porch Side entrance Master bedroom
19	Hallway light, 2nd floor Bedrooms 1, 2 and 3 Hallway, 2nd floor Storeroom Front entrance
20,21,22	Bedroom receptacles Bedrooms 1, 2 and 3
23,24	Bath lights, included with medicine cabinets Baths A and B
25	Bedroom 1 closet area light Outside bath A Master bedroom
26	Storeroom Storeroom
27	Kitchen light over sink Kitchen wall above sink

HEAT PUMP IN SOUTHERN CHURCH

proves economical during first three years of operation.

THE field-assembled water-to-water heat pump conditioning the large First Christian Curch of Chattanooga, Tenn., has shown an average operating cost over a three-year period of only 1.22 cents per cu ft of heated volume.

The equipment, wired by Terrell Electric Co., Chattanooga, consists of two 6-cylinder 30-hp compressors, seven air-handling units, two well pumps, plus miscellaneous temperature controls, alarms, motors and starting equipment. Service to the building is 4-wire 120/240 volts using seven 500MCM cables to a 600-amp service switch; distribution is through a dead-front panel containing ten pull-out type fused switches ranging in capacity from 30 to 400 amps.

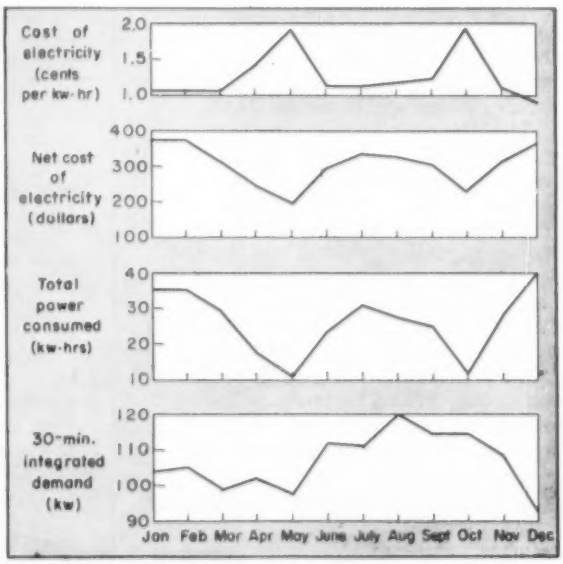
The largest air handling unit, 7½ hp, conditions the main sanctuary; others service other specific zones such as classrooms, offices and fellowship hall. Conditioning is accomplished by circulating cool or warm water through coils in the air handling units, room air being driven through the units by the individual blowers.

Water is drawn from a well several hundred feet deep outside the church by a 20-hp pump. To accomplish heating, the well water passes from the pump through a 3-way control valve to a large evaporator, where refrigerant circulates through small-diameter coils. A heat transfer takes place from the water to the refrigerant, evaporating the refrigerant. The water is then discharged into a second well about 50 ft from the intake.

The refrigerant passes from the evaporator to the condenser, where it gives up its heat to the recirculating water. This city water is independent of the well water, being recirculated in a closed system through the condenser and the seven air handling units.

To accomplish cooling, 3-way valves transfer the well water from the evaporator to the condenser, and the recirculating water from the condenser to the evaporator.

EQUIPMENT ROOM in basement contains compressors, evaporator, condenser, control valves and motor controls.



ELECTRICAL COSTS and consumption are averaged over a three-year period. Cost per kw-hr includes a demand charge of $1 per kw. Overall annual cost shows an average of 1.22 cents per cu ft of heated volume.

The refrigerant path remains the same. Thus the well water now *receives* heat from the refrigerant, and heat transfer takes place from the recirculating water to the refrigerant.

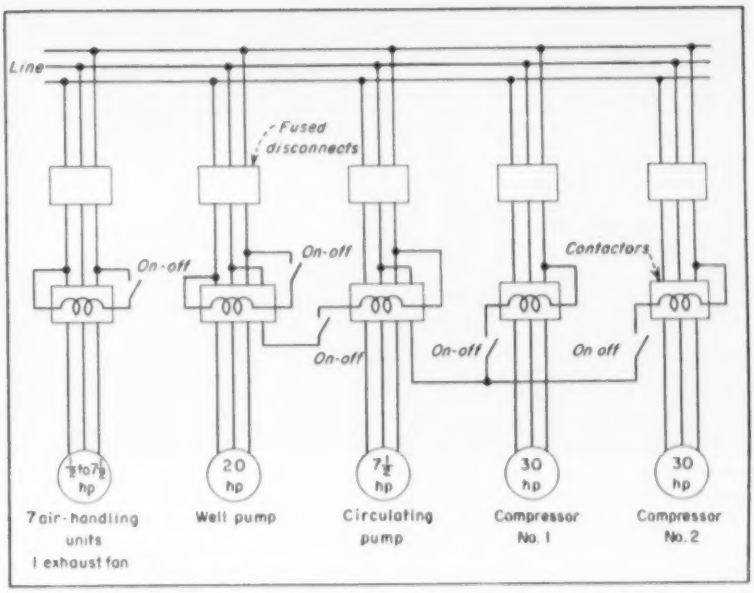
The operation of the valves is controlled manually by a summer-winter switch which causes the pressure on diaphragms in the valves to be reversed. The two compressors operate independently, except that provision is made to prevent both from starting simultaneously. The first compressor cycles at full load; the second starts and operates either at full or two-thirds load when the amount of heating or cooling required exceeds the capacity of the first unit.

All air handling units, pumps, compressors and valves are controlled by toggle switches in the main equipment room in the church basement. The blowers on the units may thus be operated independently of each other, although recirculating water passes constantly to all units. Valves at each unit permit water to by-pass units not running.

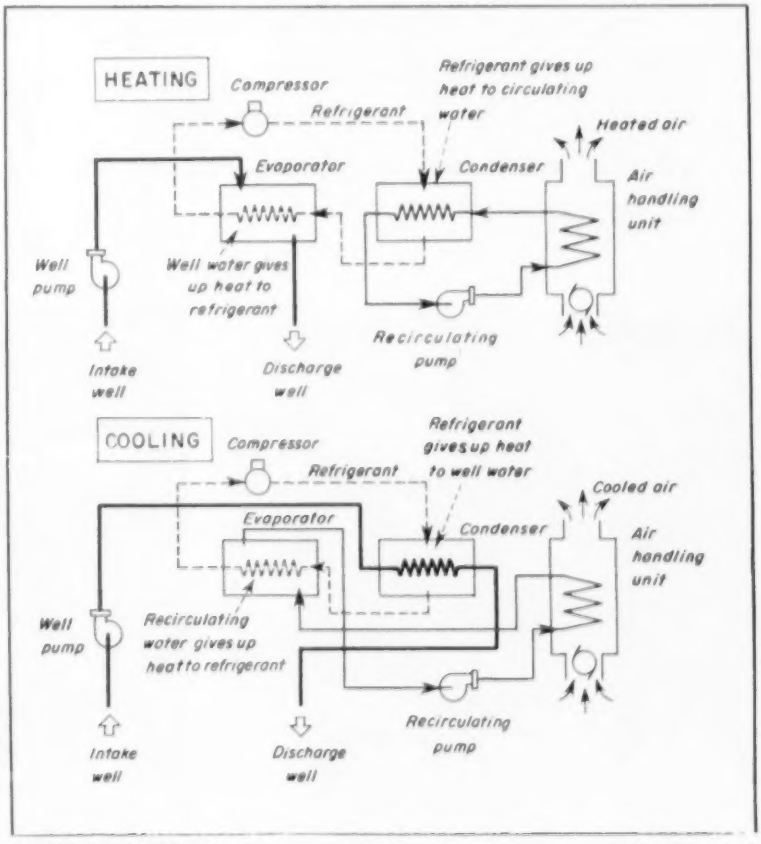
The water systems are kept in operation 24 hours a day, regardless of whether or not the building is occupied. This represents a constant night-time load of approximately 32 kw. It was found that this practice was more satisfactory than attempting to start the system for each church function.

Electrical consumption and costs averaged over a three-year period are shown in the accompanying chart. Readings were obtained through the use of a permanently connected kilowatt-hour meter measuring only the heat pump consumption of power. The demand, which averaged 106.7 kw over this period, was about half the connected load; annual load factor was 29.85%. Average annual energy amounted to 313.74 kw-hrs.

The system was designed for a 680,000 Btu/hr heating load and a 790,000 Btu/hr cooling load, to provide heating of 72 degrees F indoors at an outdoor temperature of 19 degrees, and cooling of 80 degrees indoors at an outdoor temperature of 90 degrees. Building is of solid brick construction with 2 in. of blanket-type insulation in ceiling. Total volume heated is 300,000 cu ft; average ceiling height is 17 ft in sanctuary, 11 ft in remainder of church.



CONTACTOR INTERLOCKS make it necessary to start well pump before circulating pump; both pumps must be operating to energize compressor motors. All on-off switches are in basement equipment room.



SIMPLIFIED DIAGRAM of system components show connections for heating and cooling cycles.

COMMUNITY CENTER at Weirton is $1¼-million structure designed for the wide-scope use of 87 civic groups, and financed through voluntary public subscription. Throughout the building the accent is upon decorative as well as functional lighting.

FLEXIBLE LIGHTING

. . . for all-purpose community center permits variation of illumination intensities and atmospheric effects to match requirements of social, cultural or sports event being presented.

WEIRTON, W. Va., is one of America's younger and smaller cities, having had city status for less than a decade and having an area somewhat less than 14 square miles. Its civic spirit far outstrips its size or age, however, as exemplified by the existence of a modern community center which is exceptionally well planned, designed, built and used. Conceived by a city-wide council representing 87 different community groups, this building was completely subscribed, to the extent of $1¼-million, in just 17 days; this amount

SPACIOUS LOBBY is essentially illuminated by recessed slimline and pinhole spot units arranged alternately in rows of light spaced 6 ft apart. Average intensities in large central area approximate 30 footcandles.

GYMNASIUM is lighted by twin-lensed downlights spaced on a 12-by-15-ft pattern. Auxiliary stage lighting, sound and picture projection equipment provide facilities for arranging variety of programs for community enjoyment.

being voluntarily contributed by employers and employees located within the city limits.

The result of this cooperative endeavor was the creation of a modern structure containing 68,000 sq ft, incorporating an attractive lobby, library, youth center, gymnasium and swimming pool plus a liberal assortment of meeting rooms, handball courts and related activity areas. As indicated by the accompanying photographs, intelligent attention was directed to construction, decoration, furnishings, equipment and, most of all, to planned lighting.

At night this is evident even before one enters the building, for grounds and walks are illuminated by special post-mounted spun-aluminum reflectors above upward-mounted reflector lamps; facade-lettering is floodlighted by a half dozen upwards-inclined weatherproof units located at the base and in front of the flag pole; entrance steps are safely lighted by recessed downlights in the canopy, while the attractive lobby and foyer is visible through the all-glass front.

Lobby lighting consists essentially of 13 rows of alternating fluorescent and incandescent fixtures; rows spaced on 6-ft centers with fluorescent units consisting of recessed elliptical specular-Alzak reflectors with T-6 slimline lamps operating at 200 milliamps and incandescent units taking the form of 150-watt spots. Glare is minimized due to the depth of fluorescent reflectors and the use of longitudinal louvers.

Local lighting is also provided for added emphasis (such as the striplight above and in front of the far-end mural), or for atmosphere (such as the table lamps located near walls). Intensities along these wall lines average 20 footcandles, with center-of-room readings going up to slightly over 30 fc.

The decorative scheme combines chestnut gum wall panelling; drapes of red, green, gray and white; mulberry carpeting; and furniture of gray, chartreuse and dark green leather upholstery. The dimensions of the lobby are 80 by 30 ft, with a ceiling height of 16.

The all-purpose youth room, planned for lounging, dancing and meetings, is likewise lighted by a variety of sources. For example, beams are flanked by custom-made fluorescent valances that direct louvered downlight to the floor and shielded uplight to the acoustical ceiling panels. In addition, recessed circular domes incorporate silvered-bowl lamps, while recessed pin-hole spots add further interest to the lighting plan. Separate circuiting permits these several lighting mediums to be used in various combinations for various effects.

Still another lighting treatment is to be found in the 90-by-110-ft gymnasium-auditorium, where twin lensed recessed floodlights are positioned on a 12-by-15-ft pattern. This basic lighting arrangement provides 30 fc of general illumination, although higher intensities are obtained over the boxing ring and on the stage through the use of supplemental floods, foot and border lights. A projection booth, sound equipment and wall receptacles are also provided for use in connection with movies, theatricals, meetings or exhibits. Fitted with glass backboards, collapsible bleachers and a well equipped stage, this room serves numerous purposes, can seat up to 2000 people, and is in constant use.

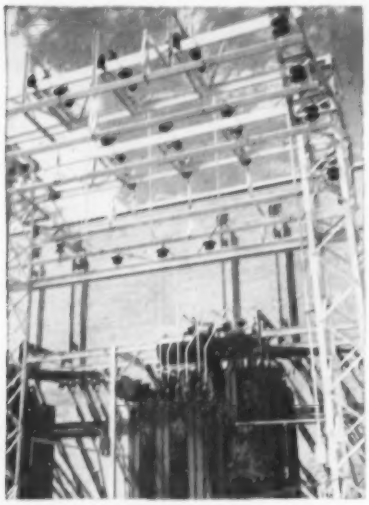
Another showpiece of the modern community center is the 75-by-35-ft swimming pool, illuminated from below by side-mounted waterproof units, lighted from above by square-lensed recessed fixtures, and additionally illuminated over the spectator galleries by enclosing globe luminaires. With its attractive green tiling and bright lane markings, this pool is ideal for aquatic meets and social swimming as well.

The electrical installation was by J. D. Kissel of Geneva, Ohio, while electrical engineering was by W. A. Porter, and architectural design was by John J. Rietz. Lighting units are predominantly Solar, Fullerton, Kurt Versen, Kirlin, Holophane and Crouse-Hinds.

This evidence of cooperative civic-mindedness is the product of public pride and public effort directed toward a common objective: a tangible example of ambitious young-community achievement at its finest.

SWIMMING POOL, illuminated through combination of underwater and overhead units, is constructed to Olympic standards, including racing lanes, spectator galleries, adjacent dressing rooms and air conditioning.

ALL-PURPOSE room in basement provides Weirton youngsters with modern facilities for social functions and casual gatherings alike. Linear valances, silver-bowl coffer treatments and recessed downlights contribute to the pleasing surroundings.



POWER FOR ALUMINA REDUCTION is obtained from 13.8-kv hollow-square busduct structure by bank of phase-shift and rectifier transformers outside rectifier building.

JOB METHODS AT MEAD

Foothill Electric Corporation of Oakland, Cal., provides massive electrical system for Kaiser's Mead, Washington, alumina reduction plant.

By Hugh P. Scott

ONE of the largest alumina reduction plants in the country is located at Mead, Wash. Operated by the Kaiser Aluminum and Chemical Corporation, it contains 119 electrolytic cells (divided into eight potlines), covers a 234-acre plant-site, and has an annual aluminum capacity of 350-million pounds.

Power for Mead's eight potlines is obtained from a huge Bonneville-Spokane substation, where five 230/13.8-kv transformer banks are combined to provide a power potential of 700,000-kva—about half of which is carried to the Kaiser Aluminum plant by multiple elevated transmission lines.

These lines terminate in eight separate hollow-square 13.8-kv busbar assemblies (interconnected through breakers and fusible links) serving voltage-regulating autotransformers. In turn (as indicated by the illustrations above), these regulating and protecting stations serve banks of phase-shift and rectifying transformers, rectifiers, positive and negative distribution bus structures and, finally, the eight potlines themselves.

Collector Buses

Mead's eighth potline installation (most recent to be completed) has a bank of seven track-mounted 6460-kva rectifying transformers; two sets of 6-phase taps fanning out from each unit to anode breakers, rectifiers, cathode breakers and a common positive collector bus structure; while transformer neutrals are connected through clamped disconnects to a common negative bus.

Rectifiers (14 in number) provide 700-volt dc at 4285 amps, resulting in a total potential of approximately 60,000 amps of power for this single potline. This power is carried between rectifier building and potline structure by the collector buses just mentioned —each bus consisting of 24 alumninum ⅛-by-10-in. bars spaced ¼-in. apart and measuring 200 ft in length.

Since previous articles have minutely discussed specific reduction equipment (see "Power for Aluminum Production", EC&M, January 1955), further mention of this subject will be omitted from this review; present attention being confined instead to *methods* used in fabricating, assembling, erecting, supporting and connecting the many high-capacity high- voltage aluminum transmission and distribution bus structures and cable installations related to this king-sized electrical system.

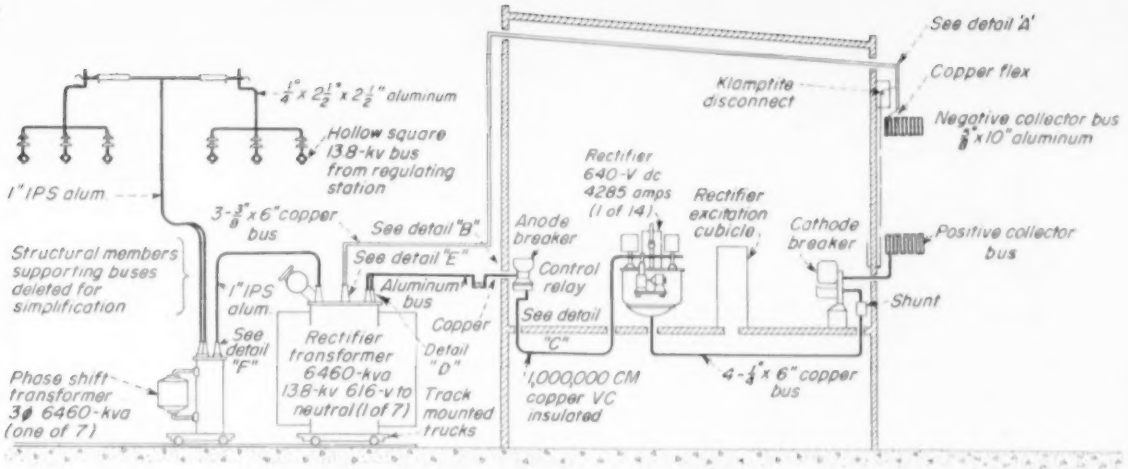
Several of these connecting and supporting methods are illustrated on following pages, such as (A) suspension details of the 24-bar negative collector bus beneath its related disconnect, (B) the transition from aluminum phase taps to copper anode breaker bus, with its related weatherproof entrance, (C) the arrangement of sheet-steel cable trays for the support of 1000-MCM copper VC cables between anode breakers and rectifiers, and (D, E and F) connections (tubular, but and flexible) of leads to and from phase-shift and rectifier transformers.

Of particular interest is the fact that both of the 200-ft-long dc collector bus structures were completely assembled on the ground, then hoisted into position as single units.

Reduction Process

Reduction of the alumina to aluminum is effected in series of shallow rectangular steel shells or "pots", each one having a carbon lining that serves as a cathode, centrally-suspended pre-baked carbon blocks serving as the anodes, and an electrolyte consisting of molten cryolyte to which aluminum fluoride has been added. Electrolyte temperatures are maintained above 1700 degrees F by the passage of large amounts of dc power between anode and cathode, and basic alumina is progressively fed into this molten bath for reduction.

In this process, reduced aluminum settles to the bottom of the pots, eventually being siphoned into a traveling crucible while additional alumina is added to keep the



BUSES FROM TRANSFORMER NEUTRALS enter rectifier building through upper wall; traverse structure below roof; then connect through disconnects to negative bus structure. Phase taps from transformers also pass through wall to anode breakers, then to rectifiers, cathode breakers and positive bus mounted on far exterior of building.

continuous cycle unbroken.

Pots are arranged in series, both physically and electrically, so that current can pass through a bus structure to the anode of the first cell, through the electrolyte and metal pad to the cathode, then again via bus to the anode of the second cell, and so on down the line. These series of cells, called "potlines", are generally arranged in two long parallel banks, so that dc power can pass down one line from a dc positive bus source, then return along the adjacent line to the negative bus structure.

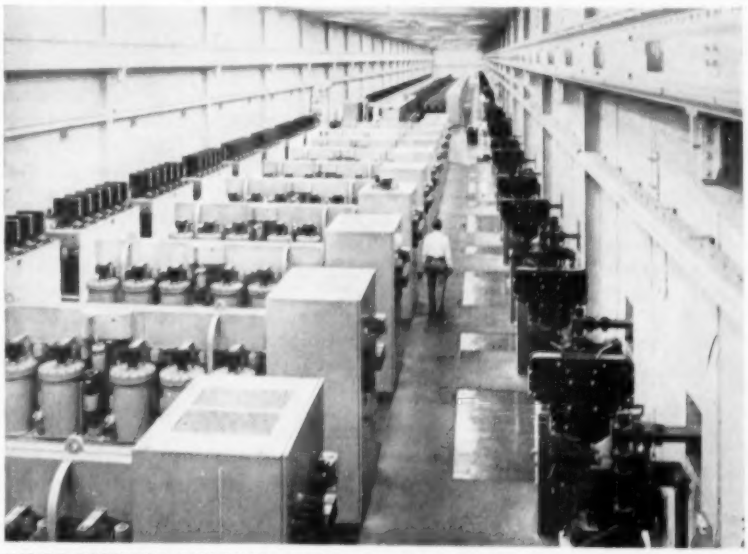
Positive current is transmitted from bus to carbon anodes through an anode bus, while negative connections are established through cathode collector bars and aluminum ring buses encircling the various pot shells. At Mead, these ring bus structures are approximately 8½ by 21 ft in plan, with inclined circuit-connecting arms consisting of six 1 by 12-in. bus slopers. Fabrication of these ring buses constituted another assembly problem for the contractor; solved by setting up a production-line field shop.

Transmission Line

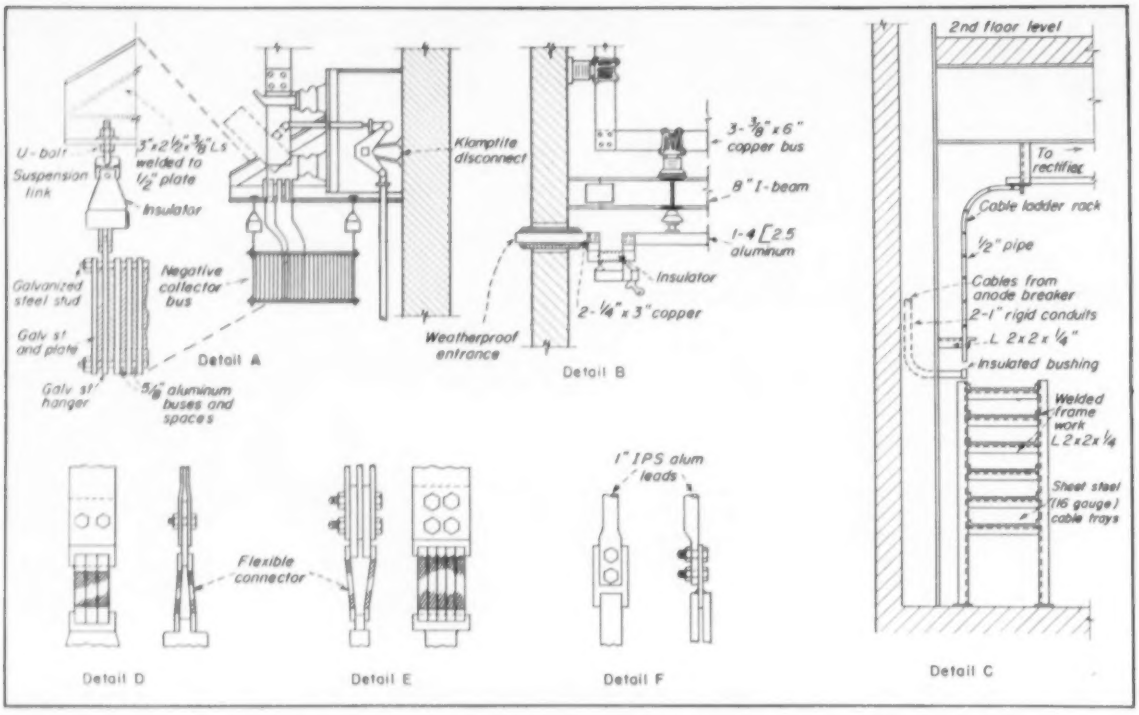
In erecting transmission lines between the Bonneville-Spokane substation and the regulating-protecting stations serving potlines 7 and 8, twin 13.8-kv feeders were supported by a common double-pole tower line. Except at terminals and turning points, these supporting structures were formed by erecting two 50-ft red cedar butt-impregnated Class 4 poles, 11 ft apart, with footings going down a minimum of 7 ft below ground level. Poles were erected with the aid of a truck-boom and winch-rig.

Phase A cables were then supported from a double crossarm at the top of each tower, while single crossarms (tiered 4½ ft apart at lower elevations) were installed to support cables related to phases B and C.

All intersections between crossarms and uprights were established by ⅝-in. galvanized machine bolts, with washers beneath bolt heads and nuts increasing the bearing areas. To prevent possible rupture of crossarms at these intersection points, main supporting bolts were flanked on either side by auxiliary



INSIDE RECTIFIER BUILDING, anode and cathode breakers are wall-mounted above and on opposite sides of rectifiers and excitation cubicles. Units are 4285 amps each.



POWER CONNECTIONS covered wide range of distribution problems concerning use of both aluminum and copper cable and bus, plus variety of supports and suspension mediums.

bolts passing through the crossarms at right angles and, to promote tower rigidity and cable support, eyebolts and turnbuckles were combined to form inclined braces at both ends of all lower crossarms.

Beneath the three tiered crossarms, ACSR lines are suspended from 2-high-tongue-and-clevis petticoat insulators; cables being supported by U-bolt suspension clamps (3 per insulator) secured to 10-in. spreader plates (see sketch).

ACSR lines (continuous for their 1550-ft length) are 1,053,500 CM, three lines being used for each phase of each of the two feeder lines. This results in a gross cable weight of over 12 tons per 1000 ft or (since towers are spaced at an average interval of 60 ft) 1460 pounds per tower.

To protect lines from the possibility of burns due to flashover or physical damage at points of attachment, they were wrapped at all suspension clamps with helical layers of aluminum alloy rods extended an equal distance on either side of each clamp. In effect, these rods provide a larger diameter conductor at support points, resulting in greater rigidity, damping of vibration tendencies, and increased cable tensile strength.

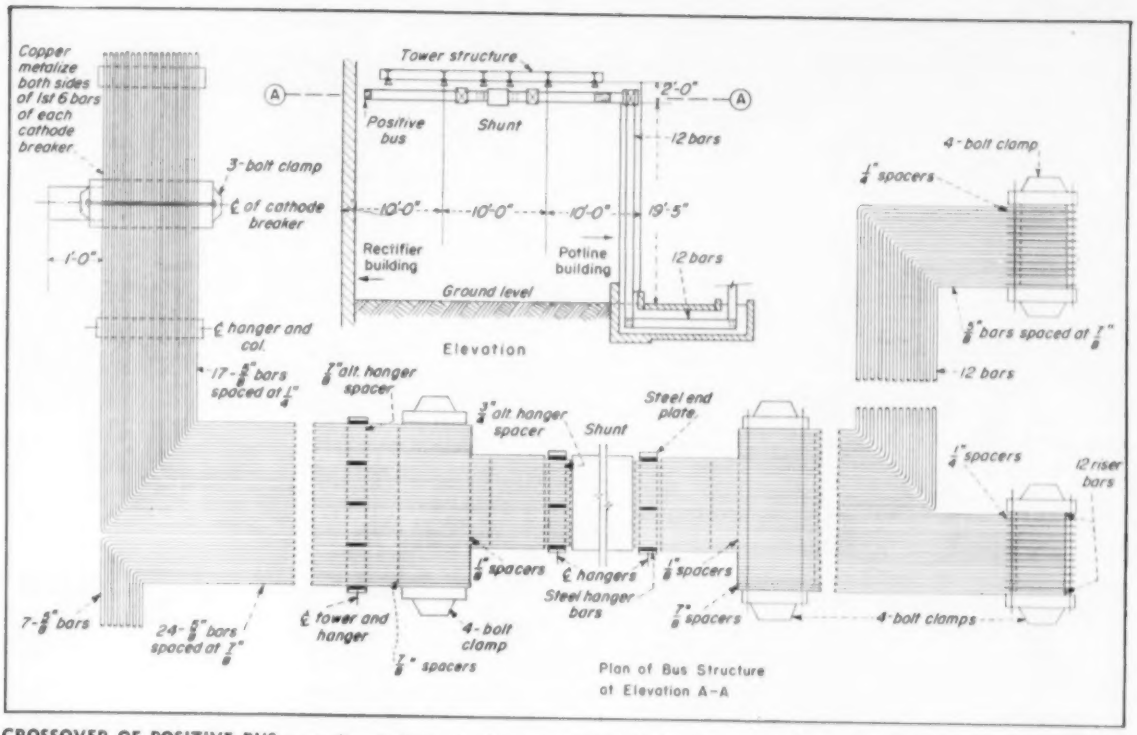
In stringing ACSR to tower crossarms, power was again provided by truck-mounted motorized winch, care being taken to protect conductor surfaces against abrasion, with the related possibility of creating corona discharge points. For that reason the conductors were trailer-mounted and freely unreeled rather than being dragged along the ground, while cradles were provided to minimize bending or scraping. Conductor surfaces were also kept free of foreign matter, grease, mud—even grass—while precautions were taken to avoid kinking or pinching the conductor insulation.

Free-running sheaves mounted on crossarms were used to reduce friction, equalize tension and obtain uniform sagging between supports. And lines were pulled up to initial sag, then snubbed temporarily, with bolted hinge-type come-alongs that gripped cables firmly without deforming them. Final pulling was accomplished without using the truck, thereby reducing the likelihood of overstressing, and securing more exact adjustment of sag between towers.

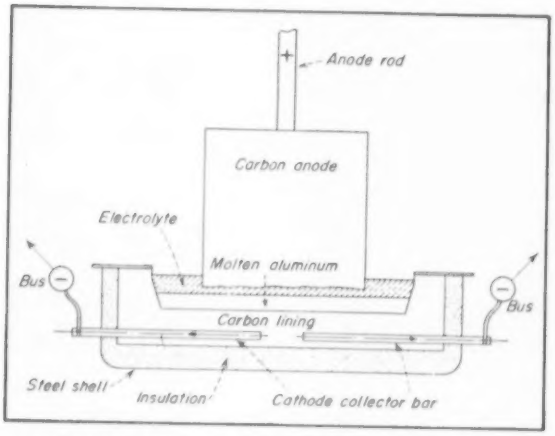
High Safety Ratio

In estimating sag distances, Kaiser engineers considered the possibility of heavy icing conditions (½-in. overall covering), plus horizontal wind pressures of 4-psf; equivalent to a velocity of 40-mph. Under these assumed severe conditions, the conductor would have a tension of 60% of its ultimate strength but, under normal unloaded conditions, tension would remain below 25% of the ultimate limit.

In dead-ending the ACSR at terminals, double-body double-clevis compression-type anchors were used, the inner body gripping only the zinc-coated steel-wire cable core, and the outer body grasping the entire ACSR assembly composed of concentrically-stranded hard-drawn aluminum wires helically wound around the inner high-strength steel center. Connector compound was used for the aluminum body, but compound was omitted when dead-ending the cable's steel core alone. These ACSR feeder lines were eminently satisfactory, combining the light weight and good conductivity of aluminum with the high tensile



CROSSOVER OF POSITIVE BUS to potline building is via tower-supported shunt-incorporating bar assembly. Bus clamps are 4-bolt units, while entrance to potline is by means of a 20-ft vertical drop to an underground reinforced-concrete tunnel.



REDUCTION POT is shallow, with suspended carbon anode block and carbon cathode lining. Molten cryolite electrolyte at 1700 degrees F frees oxygen content from basic alumina.

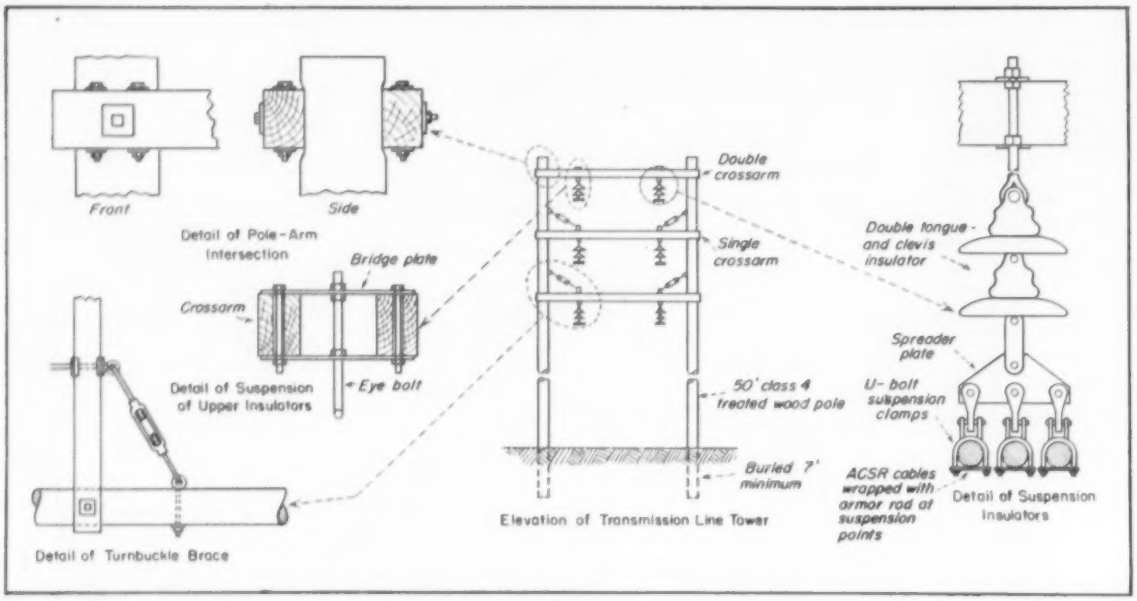
LINE OF POTS, characterized by sloping aluminum collector bars rising from pot-encircling ring-bus structures, are connected in series, power passing progressively from negative ring-bus of one pot to positive carbon anode of next.

strength of steel and using zinc coating on the steel wires to separate steel and aluminum wire reduces the possibility of galvanic corrosion, oxidation or internal rusting.

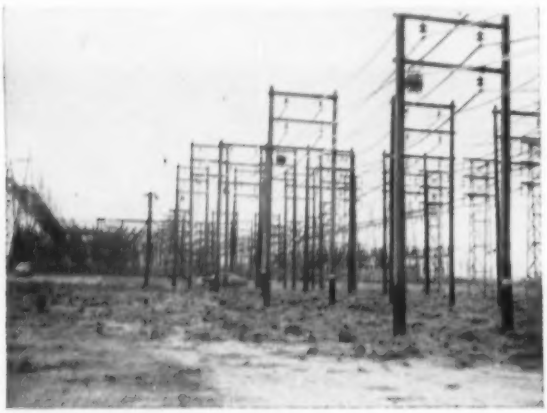
Bus Fabrication

Due to the size of this project and the multiple duplication of all electrical components, the electrical contractor naturally recognized the desirability of using production-line techniques for mass production of identical structural assemblies, and numerous field shops were set up for this purpose.

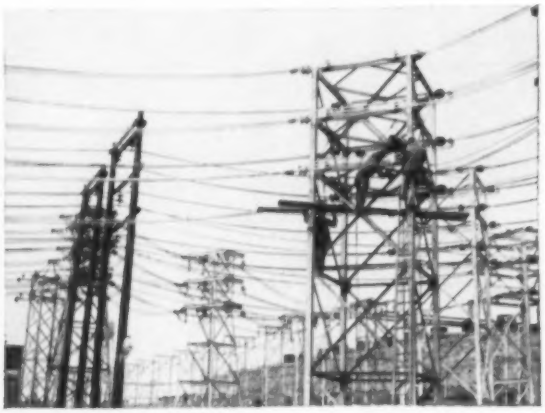
For example, in forming ring buses that surround the many electrolytic reduction cells, shop equipment was arranged in straight-line sequence so that the 1-by-12-in. aluminum bars could be progressively sand blasted, cut to specific lengths, punched for bolts, bent to shape, then welded into units. Cutting was done quickly, cleanly and accurately by means of a power draw saw. A hefty bender assured accurate angles. Finished ring buses measured approximately 8½ by 21 ft when assembled.



INTERMEDIATE TOWER supporting transmission lines consists of two 50-ft Class 4 poles with a double crossarm at the top to support Phase A cables, and two single arms beneath it to carry cables related to phases B and C. All intersection points are bolted, while added rigidity and support for suspension insulators are obtained through the use of inclined eye-bolts and turnbuckles. Three ACSR cables per phase, supported by U-bolt clamps from spreader plates, are suspended beneath tongue-and-clevis insulators.



FREE-RUNNING SHEAVES mounted on crossarms were used during installation period to obtain uniform sagging and to equalize tension on cables between supports. Cables were pulled to initial sag by bolted come-alongs, being unreeled rather than dragged, to prevent physical damage.

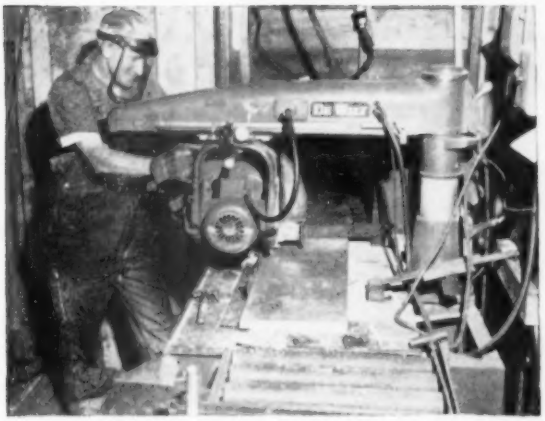


CHANGE OF DIRECTION necessitated erection of square steel tower and dead-ending of straight transmission-line segments, using compression-type anchors for that purpose. Under heavy ice-loading conditions cable tension is only 60% of ultimate strength.

As indicated in the pictures on the next page, roller conveyors were used to carry bars from one operation to the next, thereby minimizing manual effort related to handling materials during this pre-fabrication cycle. It will also be noted that many precautions were adopted to protect workers, such as the use of leather gloves to safeguard hands against aluminum splinters; masks, goggles or glass viewing windows to protect eyes; guards around punch, shear or bending points to protect fingers; foot control pedals to leave both hands free for other purposes; and steel-capped shoes to safeguard toes and feet.

By using these heavy powered machines, work was fast and of uniformly high quality. Also, by using jigs and automatic limit stops, all units were identical in shape and dimensions, contributing to precise mounting and connecting details and eliminating the need for further adjustment later.

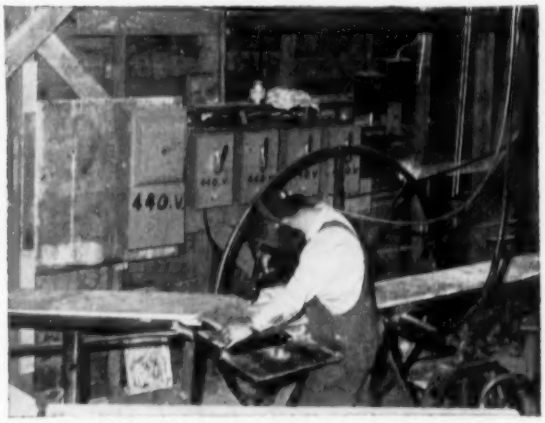
Credit for the overall design of this addition to the aluminum reduction plant at Mead, Wash., belongs to Kaiser Engineers, in cooperation with the plant's engineering group, while the merit of the electrical installation reflects a high order of workmanship and supervisory planning on the part of the Foothill Electric Corporation of Oakland, Calif.



POWER DRAW SAW cuts bars cleanly, accurately, quickly. Operator is protected against injury by face mask, leather gloves, steel-capped shoes.

PUNCH PRESS is used to install bolt holes in the inch-thick aluminum bus. Foot control pedals leave operator's hands free for accurate positioning of bars.

HEFTY BENDER in the bus shop insures accurate angles for all ring-bus sections. Ring buses, when finally assembled, measured approximately 8½ by 21 ft in plan.

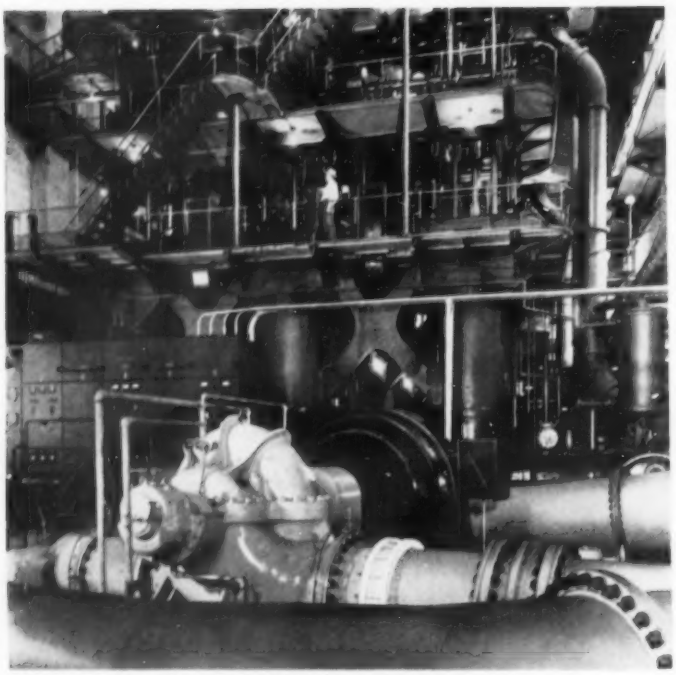


WELDING of inclined arms to ring bus was also performed on production line basis, while jigs insured accurate alignment and exact connection dimensions.

ELECTRICAL CONTRACTOR used trucks, tractors, booms, cranes, winches and wide variety of power tools to facilitate erection and installation of transmission and distribution equipment.

FABRICATION OF RING BUS assemblies begins with sand blasting; aluminum 1-by-12-in. bars passing through sanding booth on a roller conveyor. Operator watches operation through window while controlling nozzle by lever.

Motor Starting Problems on



SYNCHRONOUS MOTOR CONTROL at left is of the high-voltage current-limiting fused type for 2,000-hp motor driving modern water pump in foreground. In background is a 30-year-old pumping engine in Milwaukee pumping station.

MOTOR STARTER CUBICLES in a copper mine contain starters selected to match motor applications and maintain system voltage stability.

By H. W. Cory,

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Milwaukee, Wis.

INDUSTRIAL distribution systems are often plagued with severe transient voltage drop problems caused by the combination of large motors requiring repeated starts and long lines at relatively low voltages supplying these motors in combination with other loads. Most of these problems can be minimized by the proper selection of motor starting equipment and motor design for each motor application.

Polyphase alternating-current motors may be started directly across the line on full voltage or through intermediate steps of current reduction to reduce the voltage drop during starting. If the motor is to be started on full voltage, the motor must be capable of full-voltage starting, the driven equipment must be capable of withstanding the starting shock and fast acceleration, and the power system must be capable of supplying the starting load without exceeding safe operating limits.

A full-voltage starting controller is the least expensive and simplest of all starters. There is no limit as to horsepower, size, voltage rating, or type of motor that can be started on full voltage if conditions permit. In a recent irrigation project six 22,500-hp synchronous motors driving pumps are started on full voltage. A special line from Shasta Dam feeds the motors.

The most important factors governing the starting of motors are the power systems on which the motors will operate. When polyphase ac motors, either squirrel-cage induction or synchronous types, are started on full voltage, the current required to break away and accelerate the motor is several times full-load current and exists until the motor has nearly reached operating speed. Fig. 1 shows the

Industrial Distribution Systems

. . . . and how to solve them through proper selection and application of starting equipment. Four methods are detailed in this discussion.

full-load starting current of a 200-hp, 440-volt 3-phase, 60-cycle, 1200-rpm code F motor. Locked-rotor current or current at instant of starting is about six times full-load current. This means that the power system must furnish six times more kva to start the motor than to operate it at full load. Starting current for any polyphase squirrel cage or synchronous motor will be several times full-load current but will vary depending upon the torque characteristics of the motor. Squirrel-cage motors are designed according to NEMA type "letter designations" which describe the torque characteristics of the motor.

Fig. 2 lists three NEMA categories and their corresponding characteristics. The motor locked-rotor current has no direct relationship with motor torques, and the values of locked-rotor currents must be obtained from standard tables or directly from the motor manufacturer.

Table I shows the range of starting kva corresponding to the NEC code letter stamped on the motor nameplate. Code letters apply only to standard low-voltage squirrel-cage induction motors up to 200 hp.

No definite correlation exists between the NEMA design letter and the NEC code letter. If the actual value of the motor starting current cannot be obtained, an average value of 600% is usually assumed for squirrel cage and synchronous motors. This is usually close enough for standard equipment.

Starting motors on full voltage can produce harmful effects if sufficient reserve kva is not available from the power system. Resultant dips in line voltage may be produced by exceeding the feeder transformer capacity, excessive line loss, or a combination of both. In addition, starting currents can cause the system protective devices to open and interrupt service completely. A dip in line voltage greatly affects the equipment connected to the system. Voltage dips of sufficient magnitude can cause synchronous motors to pull out of step, release holding circuits in motor starters to stop their motors, produce serious overheating to motors, and can seriously damage the motor controllers. Motor overheating is produced because of the longer accelerating time during which the motor winding must carry starting current, and because of higher running currents with motors running at greater percent of slip. Motor starters are magnetically held in the running position and will drop out to stop the motor if the line voltage should drop sufficiently low or experience a complete outage. Motor controllers will usually open at approximately 70% of normal voltage or below. Such shut-downs often prove costly.

A transient low-voltage condition can prove detrimental to the motor

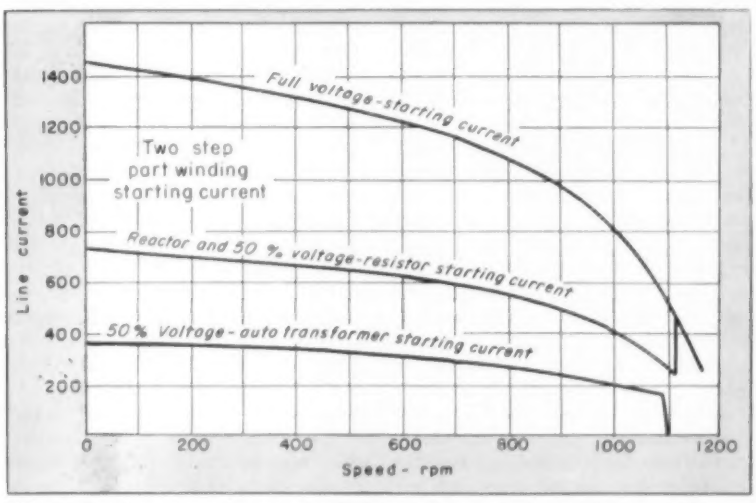


FIG. 1—Starting current curves of a 200-hp 440-volt, 3-phase, 60-cycle, 1200-rpm Code F motor. Note low current values when reduced-voltage starting is used.

TABLE I
Starting KVA Limits for Cage Motors

N.E.C. Code Letter	Kva Per Hp		Locked Rotor
A	0	—	3.14
B	3.15	—	3.54
C	3.55	—	3.99
D	4	—	4.49
E	4.5	—	4.99
F	5	—	5.59
G	5.6	—	6.29
J	7.1	—	7.99
K	8.0	—	8.99
L	9.0	—	9.99
M	10.0	—	11.19
N	11.2	—	12.49
P	12.5	—	13.99
R	14.0	—	& UP

NEMA Code Letter	Syn. Speed Rpm	Hp Range	Torques		Slip	Locked Rotor Current % of Fl Amp	Application
			Locked-Rotor % of Flt	Breakdown % of Flt			
A	3600 1800 1200 900 720 600 514 450	1½-200 1 -200 ¾ -200 ½ -200 ½ -200 ½ -200 ½ -200 ½ -200	175-100 275-100 175-125 150-125 150-120 115 110 105	Design A values are in excess of those for design B	Less than 5%		Special high break down torque high locked rotor current
B	3600 1800 1200 900 720 600 514 450	1½-200 1 -200 ¾ -200 ½ -200 ½ -200 ½ -200 ½ -200 ½ -200	175-100 275-100 175-125 150-125 150-120 115 110 105	275-200 300-200 275-200 250-200 200 200 200 200	Less than 5%	820-630 720-622 603-591	Standard characteristics suitable for most applications
C	1800 1200 900	5 -200 3 -200 3 -200	250-200 250-200 250-200	200-190 225-190 200-190	Less than 5%	820-630 720-622 603-591	Applications requiring high initial torque to start
D	1800 1200 900	½ -200 ½ -200 ½ -200	275 275 275	275 275 275	5% or more	820-630 720-622 603-591	High torque and high slip, for high inertia loads
F	1800 1200	30 -200 30 -200	125 125	135 135	Less than 5%		Low locked rotor current and torque

FIG. 2—Characteristics of NEMA design motors in three categories. Locked-rotor current has no direct relationship with motor torques and must be obtained from standard tables or motor manufacturer.

TABLE II

Locked Rotor Currents for 3-Phase, 220-Volt Motors

Hp	Locked Rotor Current, Amperes	
	Designs B, C, & D	Design F
1 Or Less	**	—
1½	35	—
2	45	—
3	60	—
5	90	—
7½	120	—
10	150	—
15	220	—
20	290	—
25	365	—
30	435	270
40	580	360
50	725	450
60	870	540
75	1085	675
100	1450	900
125	1815	1125
150	2170	1350
200	2900	1800

NOTES: ** 25 amps per horsepower.

For other than 220-volts, current shall be inversely proportional to the voltages.

The locked-rotor current of single-speed, 3-phase, constant speed, integral horsepower squirrel-cage induction motors, when measured with rated voltages and frequency impressed and with rotor locked, shall not exceed the above.

controller. A dip in line voltage may not be low enough to fully open the starter switch but would allow it to open partially and immediately reclose. Pressure is lost on the line switch contacts and severe arcing and burning, or even welding together, of contacts could occur. Such failures on controllers are common where starting of motors causes line voltage drop and the voltage builds up as the motor comes up to speed. Low line voltage during starting and running is the most common cause of motor controller failure.

The minimum operating voltage permitted by the manufacturer's motor guarantee is 10% less than rated nameplate voltage. Load characteristics of the motors cannot be obtained if the operating line voltage should fall below this point. The minimum voltage permitted for the operation of motor controllers is 15% below the nameplate rating. Several cases have been found where motors would fail to develop sufficient torque to accelerate their loads on Monday morning, but would start successfully on the following mornings. Usually this condition was due to a low-voltage condition produced by all plants in an area attempting to start at exactly the same time. The low line voltage greatly reduced the starting torque. This minimum should not be exceeded during the acceleration or during normal operation of the motors.

The drop through power system conductors may not be a factor during normal operation of motors but can prove serious during the acceleration of the motors.

Line drop in motor circuits is frequently approximated on the basis that 1 volt will be allowed in the branches, two-thirds of the remaining drop in the mains and one-third in the feeders. Most of the drop should be confined to the mains so that a variation in the load on one motor of a group will affect the others as little as possible. Where a group of motors is fed by a main and branches, the drop in the branches if they are not too long is frequently 1 volt or less, under normal working conditions. This results from the NEC requirement that a branch motor conductor have a carrying capacity at least 25% greater than the normal motor full-load current.

Selective Starting

Low line voltage can be produced by attempting to start too many motors at one time or through incorrect sequence. Motors should not be started simultaneously if their starting causes an excessive drop in the line voltage. They should be started individually or in blocks of permissible size. If large and small motors are to be started on a common power system, best results are obtained by starting the largest sizes first and the smallest sizes last. This gives the larger motors advantage of the full line capacity. If synchronous motors are on the system with other types of ac motors, the synchronous motors should always be started first. Synchronous motors will draw less kva from the system than the other types of motors and can supply reactive power to the system if allowed to run unloaded or overexcited.

Although systematic starting permits motors to be started successfully without an excessive line-voltage drop, the line must still be protected while the motors are running. When 3-wire control circuits are used as shown in Fig. 3-A, a severe dip in line voltage or a momentary complete outage causes the control sealing circuits to be broken and the controller will drop out to stop the motors. This type of controller operation is called "low-voltage protection". It affords maximum protection to the system by not permitting all motors to accelerate back to full speed after being slowed down due to the voltage dip. Many operators object to this arrangement because all motors are lost from the line during the voltage dip and each must be restarted as on the original start. To overcome this objection circuits are available which permit the dropout of the controllers on low-voltage dips but allow them to automatically restart if normal voltage is restored within a preset time delay. Such a "time-delay undervoltage protection" circuit is shown in Fig. 3-C. The usual time delay can be set up to two seconds.

Time-delay undervoltage features on controllers do prevent some complete shutdown, but their wide use should be viewed with caution. If all motor controllers on the system had such features, a restoration of voltage within the time-delay setting after a voltage dip would cause each motor to attempt to accelerate simultaneously and excessive currents would flow. If the power system were not capable of the demand, the line voltage would fall and the currents would go still higher. As a result, the system would bog down completely and the motors would stall. The backup protection devices and starter overload devices would then disconnect the system. A compromise is sometimes possible with the use of the time-delay undervoltage controllers. All the motors on a system can be given priority listing according to their operating importance. The high priority units can be equipped with time-delay undervoltage protection, with the time-delay set at varying intervals and with the most important unit having the longest time setting. The lower priority units would have only low-voltage protection and would not automatically restart. Type of combination will depend upon the various sizes and types of motors, types of loads, and system capacity. It must be determined for each individual system. Controllers can be sequence-interlocked so that upon the starting of one unit a second unit will automatically be started after a set time delay.

There is one other control

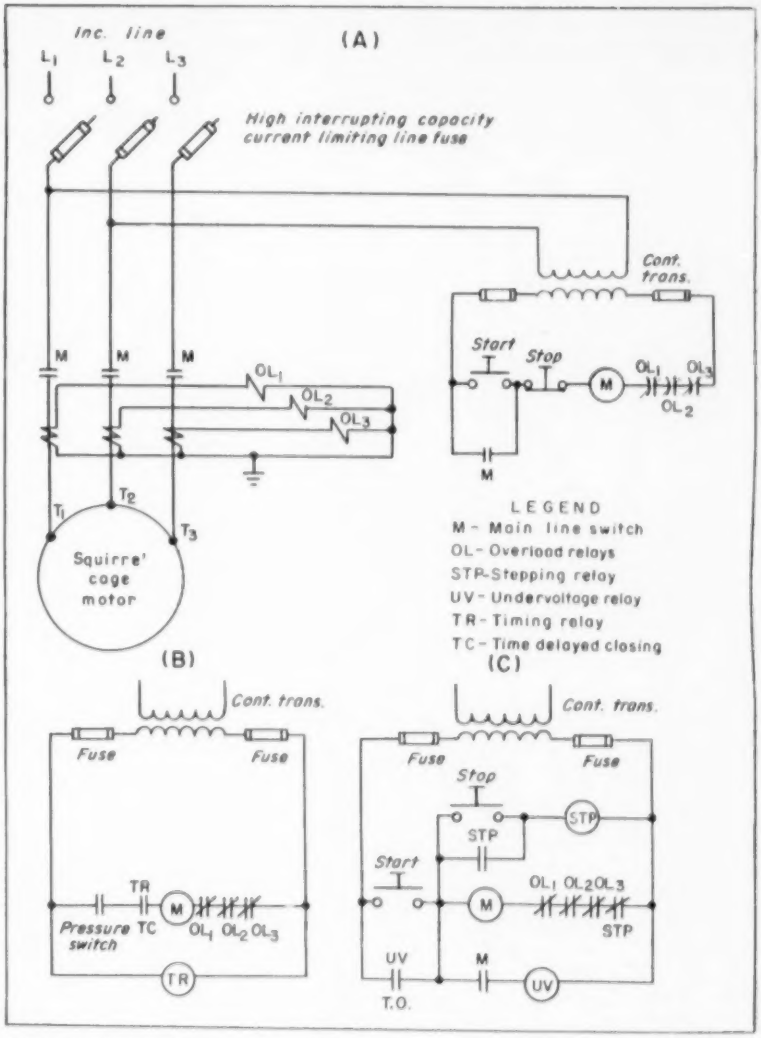


FIG. 3—Circuit diagrams for full-voltage squirrel-cage motor controllers showing: (a) simple low-voltage protection; (b) addition of time-delay relay for restarting in conjunction with a demand device (pressure switch, etc.); and (c) time-delay undervoltage protection, using timing relay for automatic restarting if normal voltage is restored within a preset time delay.

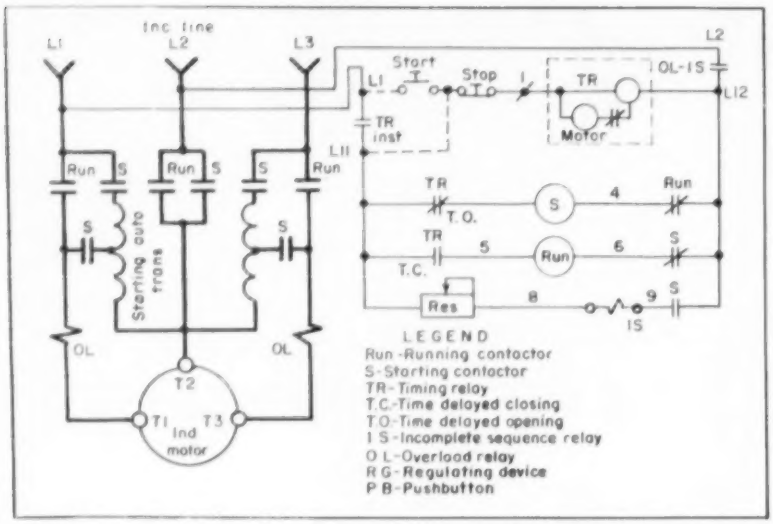


FIG. 4—Autotransformer starting diagram for squirrel-cage motor controller with voltage taps at 50%, 65%, and 80% of full voltage. Starting autotransformer is of two-leg type used in standard controllers.

method which can cause all motors to start simultaneously to pull down the line voltage. This arrangement is through a demand device, such as a pressure switch, float switch, temperature switch, etc. These devices automatically start and stop motors as the demand requires. On severe voltage dips, or complete voltage failures, the motor controllers drop open to stop the motors even though the demand switch is closed. On restoration of full voltage, all units will attempt to restart together. This proved disastrous on several installations where several large pumps and compressors were automatically controlled. This operating hazard can be overcome simply by adding a time delay in the starting of each motor after the demand contact has closed. The time delays in the various units are staggered so that, on restoration of voltage, only one unit at a time will be started. Such a circuit is shown in Fig. 3-B. Most motor controllers are furnished as standard with "low-voltage protection" feature for 3-wire control from a momentary pushbutton station. Time-delay undervoltage protection should be used only on units where shutdowns on momentary voltage fluctuations cannot be tolerated. The time-delay feature for staggered starting is not included in the base prices but can be obtained for an additional price in any high- or low-voltage controllers.

If starting kva must be limited because of motor construction, nature of driven equipment, or power system limitations, there are several methods to choose from. Each method has its advantages and disadvantages, and the application must depend entirely upon the power system to which the motor and controller will be connected. The following starting methods apply equally to squirrel-cage induction motors and synchronous motors with built-in starting windings.

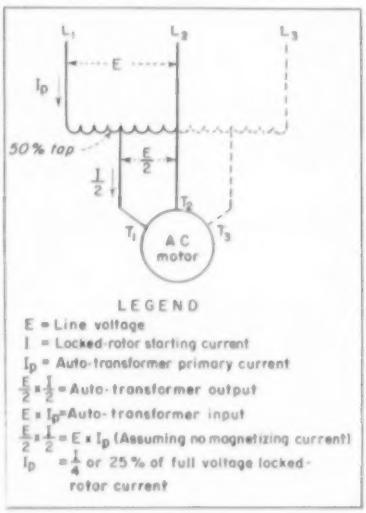


FIG. 5—Relationship between autotransformer tap voltage and line starting current. Starting line current is equal to (percent voltage tap) times two times locked-rotor current/100.

Autotransformer Starting

The most common of all methods for limiting starting current is a starting autotransformer. A typical circuit for a low-voltage autotransformer squirrel-cage controller is shown in Fig. 4, and is available in sizes up to several hundred horsepower ratings in both the low- and high-voltage classes. Autotransformers are intermittently rated for light duty, medium duty, and heavy duty applications. The starting autotransformers can be either 2-leg or 3-leg types when applied to 3-phase controllers. Two-leg types are used in standard controllers. The use of the 2-leg element (Fig. 4) causes a voltage unbalance of about 15% while the unit is supplying reduced voltage to the motor terminals. Except in very special applications, this unbalance is of no concern and the 2-leg units permit use of less expensive controllers.

Current taken from the line to start polyphase motors is reduced by reducing the voltage to the motor terminals and causes the motor to accelerate to a definite speed or current point. This is accomplished with the motor controller which connects the autotransformer to the line and to the motor. Voltages on the motor terminals is set by the tap connections made to the autotransformer. Most controllers are equipped with medium duty units and are connected at the factory to the 65% taps. The controller will automatically disconnect the autotransformer and connect the motor to the line on full voltage. Definite time relays or current relays are used to produce the transfer.

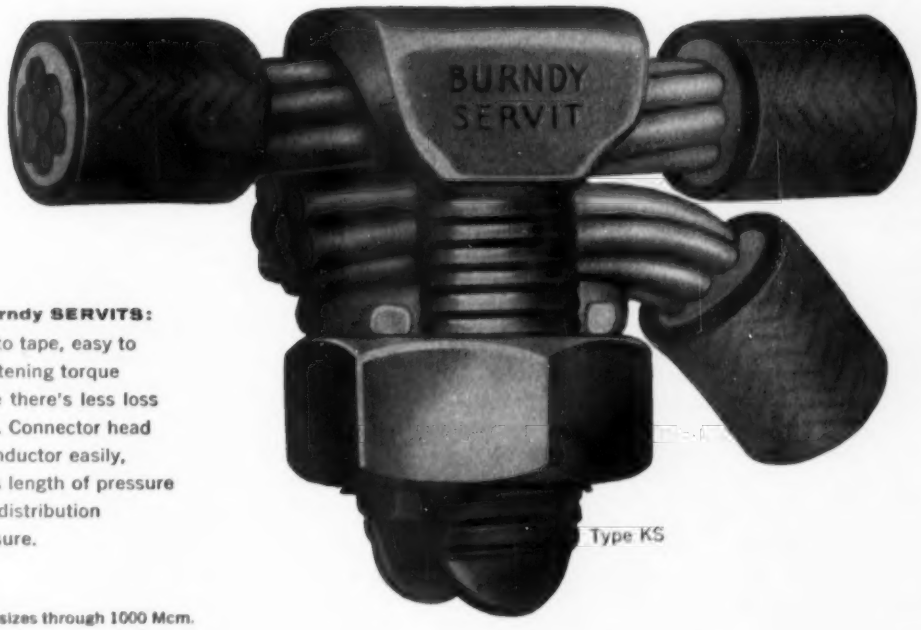
When starting a motor with an autotransformer type of controller the minimum voltage tap that will adequately accelerate the motor and its connected load should be used. The motor should reach its maximum speed before transfer to full voltage occurs. This is very important to minimize the line disturbance and to reduce arcing on the controller line switches.

When applying autotransformer controllers, there is one important fact to remember. When transfer to full voltage occurs, the circuit to the motor is completely interrupted and reconnected. If the motor has not accelerated sufficiently, the current at transfer to

"Is this size approved?"

"brother... they're ALL approved!"*

SERVIT



Type KS

Know your Burndy SERVITS:
Compact, easy to tape, easy to install; less tightening torque needed because there's less loss through friction. Connector head fits over run conductor easily, exactly matches length of pressure bar for greater distribution of contact pressure.

*on all sizes through 1000 Mcm.

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55-10

Norwalk, Connect. • Toronto, Canada • Factories: New York, California, Toronto • Export: Philips Export Company

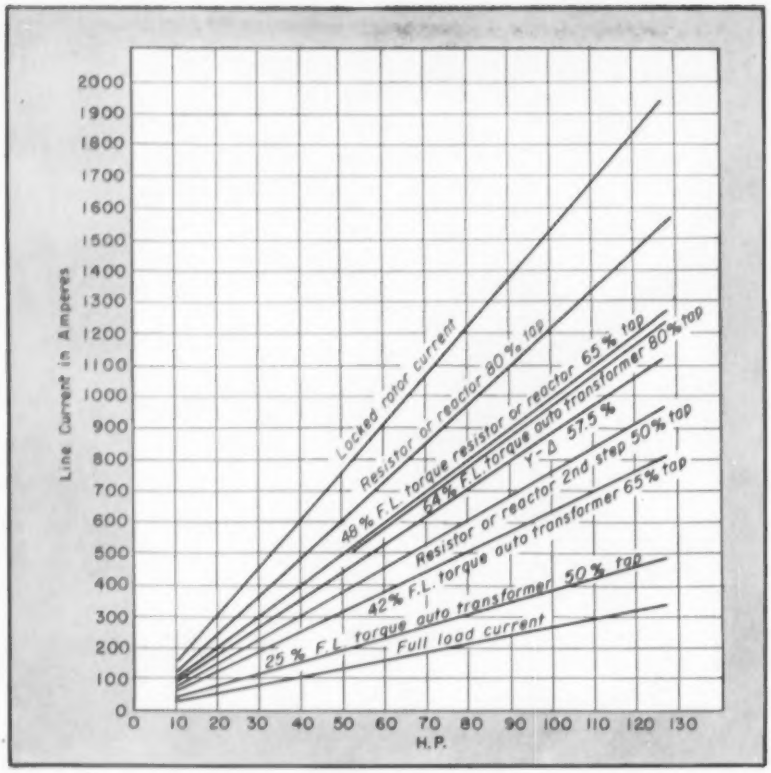


FIG. 6—Horsepower-current curves for squirrel-cage, Code F motors, 3-phase, 60-cycle, 1200 rpm, 208-volts. For 220 volts, multiply values by 0.94.

full voltage can be much greater than the current taken from the line at the instant of starting. It can be almost as much as full-voltage locked-rotor current. This can be seen from the full-voltage current starting curve and the 50% autotransformer current curve in Fig. 1. Transfer to full voltage was purposely drawn to occur at 1100 rpm to illustrate how the current can be higher than at the instant of starting. At zero speed the line current was only 380 amps, but at 1100 rpm the line current jumped to 550 amps. If transfer occurred at 1100 rpm, the line current would have been 820 amps. *The autotransformer voltage tap and transfer point to be used should be selected so that the current at transfer does not exceed the zero speed current.* If the current is exceeded, the advantages of reduced current starting are lost and the motor might just as well be started on full voltage. The proper autotransformer tap and transfer setting usually must be selected by trial. The minimum tap possible should be used.

Autotransformer starting provides greater starting torque per ampere than any other type of reduced current starting. The current taken from the line is proportional to the % starting voltage (2/100). When the 50% tap is used, only 25% of the current is taken from the line as would be taken on full voltage starting. The 80% tap will allow 64% of the full-voltage starting current. This can best be visualized by working from the secondary of an autotransformer winding, as shown in Fig. 5. Assume that the full-voltage locked-rotor starting current of a motor is equal to I. If a 50% autotransformer tap is to be used for starting, 50% of the line voltage E/2 will appear on the motor terminals. If the voltage is reduced by one-half, the current through the motor winding will be just half the value it would have been on full voltage (or ½). The volt-amp output of the autotransformer is then E/2 x ½. Assuming there is no loss in the autotransformer, the primary input must equal the output. Since the primary voltage is E or full voltage, E½ = E x I primary. I (primary) = ½ or 25% of the full-voltage locked rotor current. The magnetizing current of autotransformers runs from about 5% to 10% of total line current and must be added to the value of the line current if accurate calculations are required.

Primary Reactor and Resistor Starting

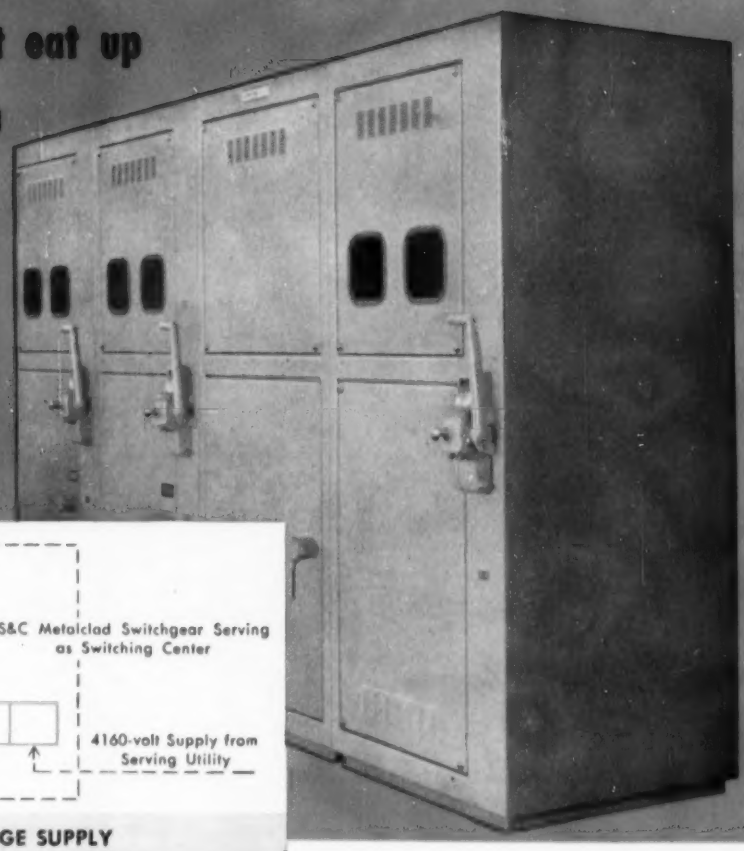
Another way to reduce the starting current consists of placing a reactor or resistor element in series with each phase of the motor to reduce the terminal voltage on the motor. The elements are left connected until the motor has accelerated sufficiently so that transfer to full voltage can occur with minimum line disturbance. Transfer can be accomplished either with time-delay relays or with current relays similar to the autotransformer type of controllers. After transfer has been completed, the starting elements are either disconnected from the circuit or shorted out during normal operation. The transfer from reduced voltage to full voltage occurs without any interruption in the power connection to the motor.

Reactor and resistor starting does not limit starting current to the same extent as autotransformer starting. *Starting currents with reactor or resistor are directly proportional to the voltage taps.* A 50% reactor or resistor voltage tap limits the starting current to 50% of the full-voltage value, whereas the 50% autotransformer tap limited the current to only 25% of the full voltage value. However, the closed transition feature can be of great importance on systems equipped with voltage regulation means. Even though the current at transfer may be greater than starting current, the rise in current is only an addition to the starting current and not from zero as it was for the autotransformer starting. This condition is shown for the reactor starting curve in Fig. 1. The current jumps to 500 amps at transfer, but this is only a step of 230 amps above the starting current. Even if the transfer had occurred at 100 rpm, the full-voltage current would only be a step of 720 amps above the starting current. Reactor or resistor method of starting also permits balanced currents for the starting of the motors.

Most standard reactor and resistor starters are designed for two-step starting, one step on reduced voltage and the final step to

Why let costly equipment eat up the savings you get from a HIGH-VOLTAGE POWER SYSTEM?

For *half the cost*, S&C Metalclad Switchgear provides protection and switching for circuits in industrial and commercial installations



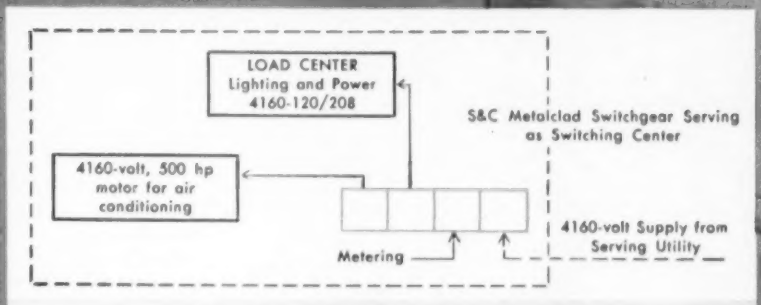


DIAGRAM OF HIGH-VOLTAGE SUPPLY

The new eastern service office of Kemper Insurance in Summit, N. J., presented a typical switching and protection problem with its combination lighting and power loads. Since this high-voltage system will seldom be exposed to faults, and will require only occasional switching, the simple radial form of power distribution is used, and high priced protective equipment that incorporates automatic reclosure for transient faults is unnecessary.

By selecting the 4-unit assembly of S&C Metalclad Switchgear, shown above, Childs and Smith (Chicago architect-engineers) met the demands of this de luxe building at about half the cost of other switching and protection equipment.

S&C's experienced staff, backed by years of pioneering activity for the electric utilities, is equipped to suggest high-voltage supply systems for your special requirements . . . and to eliminate the premium costs of complex switchgear. S&C engineers will be glad to work with you.

Chas. R. Kuglin, Chief Engineer for Childs & Smith

specified S&C Metalclad Switchgear for the new Kemper Insurance Company building. He says, "S&C gear enabled us to meet all the requirements of this particular installation and provide our customer with reliable protection."

Specialists in High-Voltage Circuit Interruption since 1910

S&C ELECTRIC COMPANY

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In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario

Consult your telephone directory. **Sales offices in Birmingham, Boston, Buffalo, Chicago, Cleveland, Columbia (S. C.), Dallas, Dearborn, Denver, Houston, Huntington, Indianapolis, Jersey City, Kansas City, Little Rock, Memphis, Minneapolis, New Orleans, Philadelphia, Phoenix, Pittsburgh, Portland (Ore.), St. Louis, St. Petersburg, Salt Lake City, San Francisco, San Gabriel (Los Angeles), Seattle, Syracuse, Washington, D. C.**

full voltage. Both types are readily available with more than two starting steps. With a greater number of steps the current values per step will be decreased proportionally.

Wound-Rotor Motor Starting

All of the starting methods previously covered were for the starting of either squirrel-cage induction motors or synchronous motors. Wound-rotor induction motors are used to obtain smooth starting and acceleration to protect the driven equipment or power systems and to obtain speed control.

Although wound-rotor motors are started directly across the line, the motor controllers can cause them to accelerate smoothly and efficiently, with initial starting currents less than that required for other types of motors. The rotor or secondary slip rings are connected to resistance banks of definite values for each of the secondary phases. The motors are started with the total resistance in the circuit. By shorting out specific sections of the secondary resistance in sequence, the motors accelerate through a series of definite speed-torque characteristic points corresponding to the number of resistance steps and the value of the resistance at each step. The number of steps or speed points is always one greater in number than the number of shorting switches.

Stepless starting can be obtained by the use of liquid rheostats in place of secondary resistors and shorting switches. This type of controller is comparatively expensive and used only for special applications.

The value of the starting current of wound-rotor motors can be limited to specific values by the design of secondary resistor banks.

The most important consideration in selecting the type of motor starting equipment is the power line stability. Low line voltage during starting and normal operation of motors is without doubt the most common and most damaging hazard to power distribution systems. Inadequate line stability is responsible for motor overheating and burnouts, damage to controllers, unscheduled shutdowns and light flicker. Low line voltage may be caused by overloading of transformers, insufficient capacity of transmission lines and cables, and low system power factor.

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Please send free brochure describing Bronco 66 Certified.
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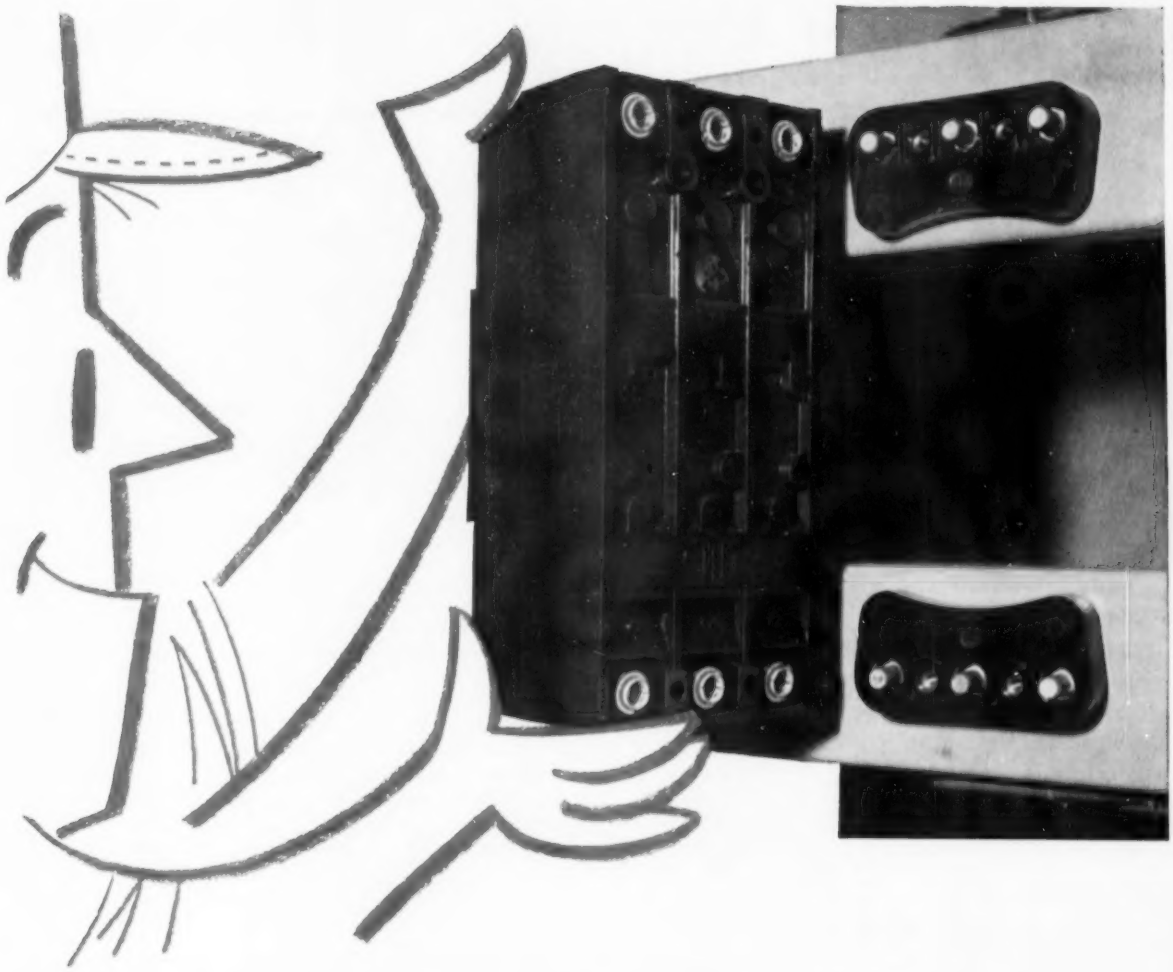
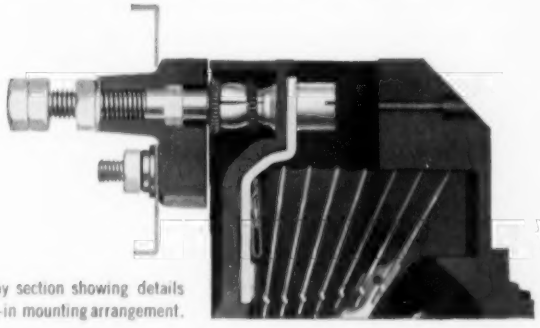
WRITE for the complete story of BRONCO 66 CERTIFIED, the cable with 67.32% Neoprene in the jacket!



Ordering Switchboards? Specify Plug-In Mounting of Molded Case Circuit Breakers

Consider the advantages of I-T-E Plug-In Mounting. The added safety of concealed breaker terminals with no live parts exposed. The flexibility of changing breaker ratings within a frame size. The ease of installation and removal. When you do, you'll specify switchboards with this time-proved method of installing molded case circuit breakers—used for many years in maritime switchgear and approved by Underwriters Laboratories Inc.

I-T-E plug-in molded case circuit breakers are available in ratings from 15 to 600 amp, up to 600 volts a-c, 250 volts d-c. Contact your I-T-E representative or leading independent switchboard manufacturers for details. Or write Small Air Circuit Breaker Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Phila. 30, Pa.



Cutaway section showing details of plug-in mounting arrangement.

I-T-E CIRCUIT BREAKER COMPANY

Small Air Circuit Breaker Division

Practical Methods

DOUBLE-BRACKETED POLE LIGHTS, each supporting two 400-watt fluorescent-mercury lamps in OV-20 luminaires, brightly illuminate modern shopping center in Rochester, N. Y.

Fluorescent-Mercury Lamps Illuminate Shopping Center

LIGHTING

After-dark customer attraction, sales appeal and promotion is effectively obtained at Rochester, N. Y.'s, recently completed North Gate Shopping Center by means of a street lighting installation that offers motorists a brilliantly warm invitation to stop and shop. The installation includes 33 double-bracketed 28-ft poles spaced on a 90-by-120-ft pattern, each pole equipped with two Westinghouse OV-20 luminaires equipped with 400-watt J-H1 fluorescent-mercury lamps. This shopping center, presently containing 25 store units and offering parking facilities for over a thousand cars, is winning favorable comments from shop owners and customers alike, and the lighting installation is already serving as a model for similar shopping centers throughout upstate New York. Lighting layout was specified by Rochester G&E engineer Vince Mitchell, and system was installed by William Kollock and Son, the electrical contractors.

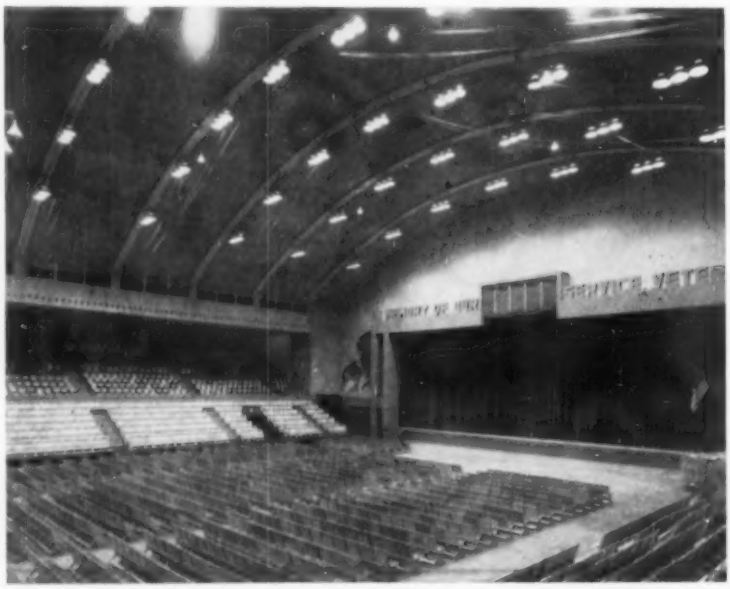
Auditorium Has Good Lighting Plan

LIGHTING

The Onondaga War Memorial Auditorium in Syracuse is becoming increasingly familiar to T-V sports followers, for many top-flight professional and amateur events are being telecast from this arena. Quite naturally, the area most familiar to home T-V viewers is the 33,000 sq ft main hall, where general illumination in the order of 72 footcandles is provided by heavy duty Holophane Hibay reflectors equipped with 1000-watt inside-frosted mogul-base PS52 incandescent lamps. Reflectors, grouped in three's, are spaced on 19-by-15-ft patterns across the 60-ft-high arched roof, thereby accounting for a connected lighting load of 10 watts/sq ft.

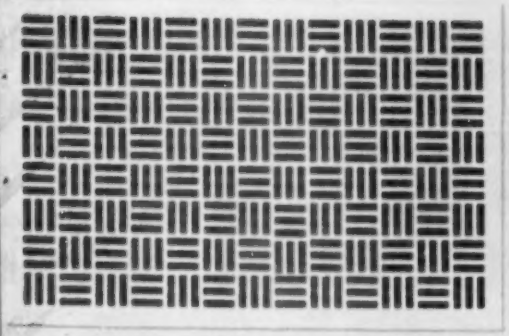
This general illumination level may be boosted materially over local areas by means of special auxiliary incandescent groupings positioned above basketball backboards, ice hockey cages or a central boxing ring. Also, for pageants, ice shows and the like, batteries of flood and spotlights may be trained upon performers or specific local areas, these lights being located along liberally dimensioned galleries that overhead the permanent seats in side arenas.

Not only do these galleries pro-



MAIN HALL has lighting level of 72 fc, provided by Holophane Hibay reflectors equipped with 1000-watt lamps. Auxiliary lighting is also provided for stage presentations, sports events, pageants and the like. Galleries over side arena seats incorporate air-conditioning exhaust ports and spotlighting equipment. Loudspeakers for music or public address are contained in enclosure above stage.

LGB-24



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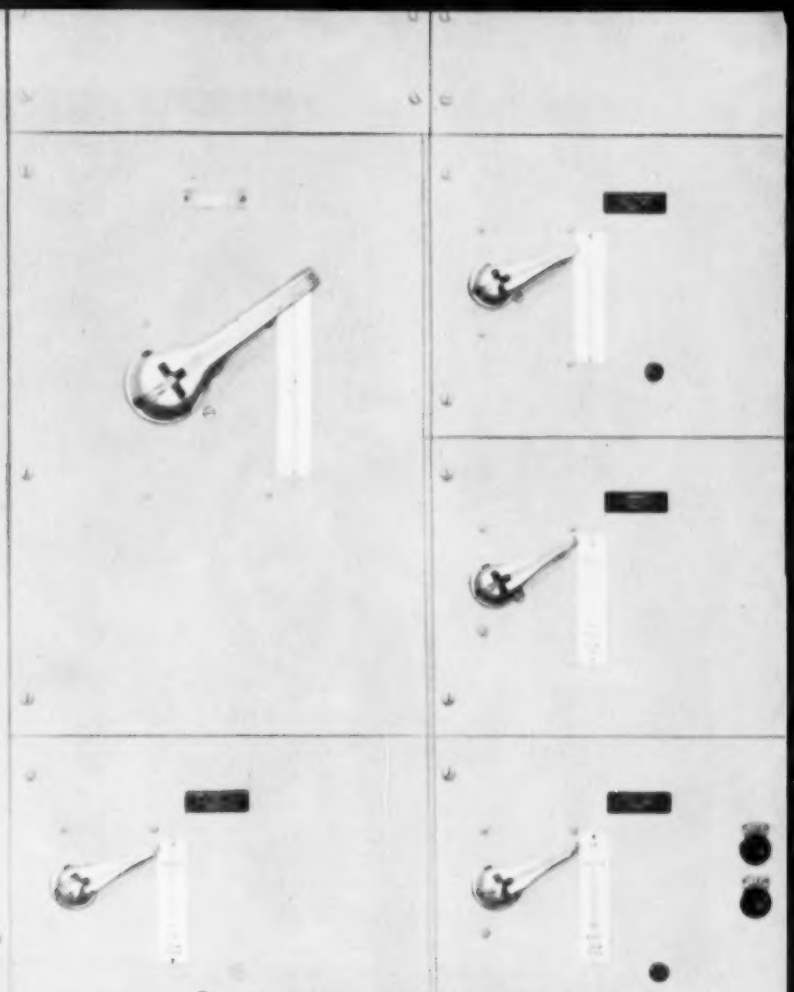
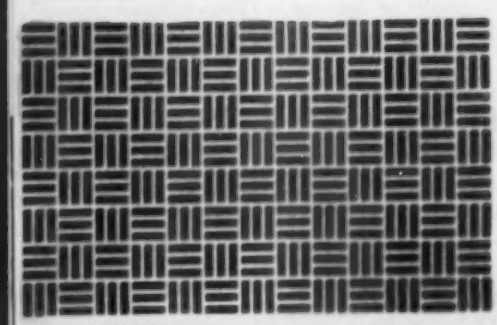
150 KVA 3PH.
480/120-208 V.

•WESTINGHOUSE•

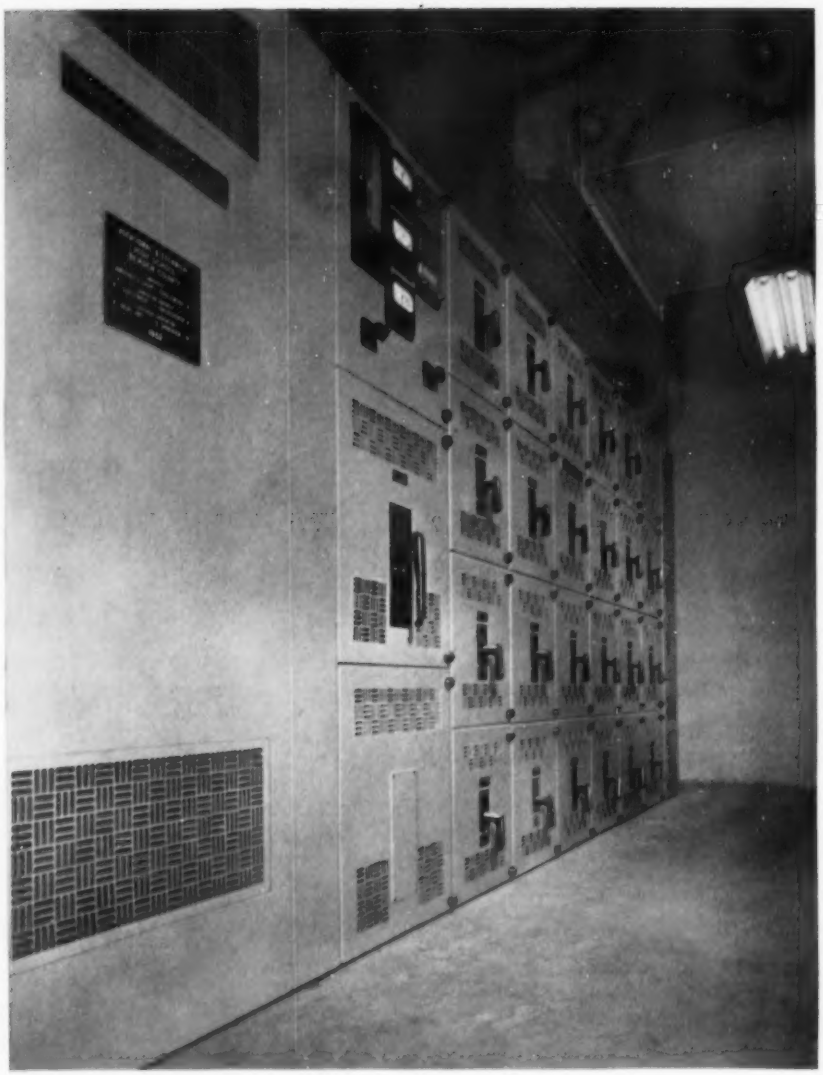


How you can increase your production efficiency



WATCH WESTINGHOUSE! →

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***



Slice Installation Cost With Westinghouse Pre-assembled Switchgear

It's axiomatic: the lower your costs the higher your profits. With heavy-duty electrical equipment, high installation cost sometimes knocks profits out of the picture. Not so with Westinghouse switchgear.

Westinghouse pre-assembles units in the factory according to your specifications. You get custom-built voltage protection at rates comparable to mass-produced standard equipment.

The bonus with Westinghouse switchgear is precision engineering of basic design plus quality control throughout manufacturing and assembly.

You get many other benefits: built-in circuit breaker protection, assurance of minimum voltage variation, and many others. See your Westinghouse distributor for details, because you can be sure if it's Westinghouse.

DP-5027-A

Westinghouse Panelboards Keep Your Circuits 100% Flexible

You can convert or expand or change over distribution panelboard branch circuit requirements without unnecessary expense—if those panelboards are Westinghouse. The only tool needed is a screw driver.

Quick production changes require the flexibility in distribution equipment that Westinghouse CDP panelboards give. Quick changes to the correct protective device for equipment mean less down time and a resulting higher production output. More profits.

In CDP panelboard (shown), this conversion can be made easily because Westinghouse provides pre-drilled and pre-tapped busbars, back pan, and other standardized parts. One or more breakers can be replaced with larger or smaller ones to match changing circuit-protection requirements.

There is a Westinghouse panelboard to fit *your* requirements (see below). DP-5027-B

WATCH the WESTINGHOUSE sponsored convention telecasts August 12, Democratic Convention— August 19, Republican Convention.

NPLB Panelboard—factory-assembled lighting panelboard.

Add-A-Cirkit Panelboard—breakers for new circuits easily added.

CDP Panelboard—permits maximum rearrangement flexibility.

WATCH WESTINGHOUSE!

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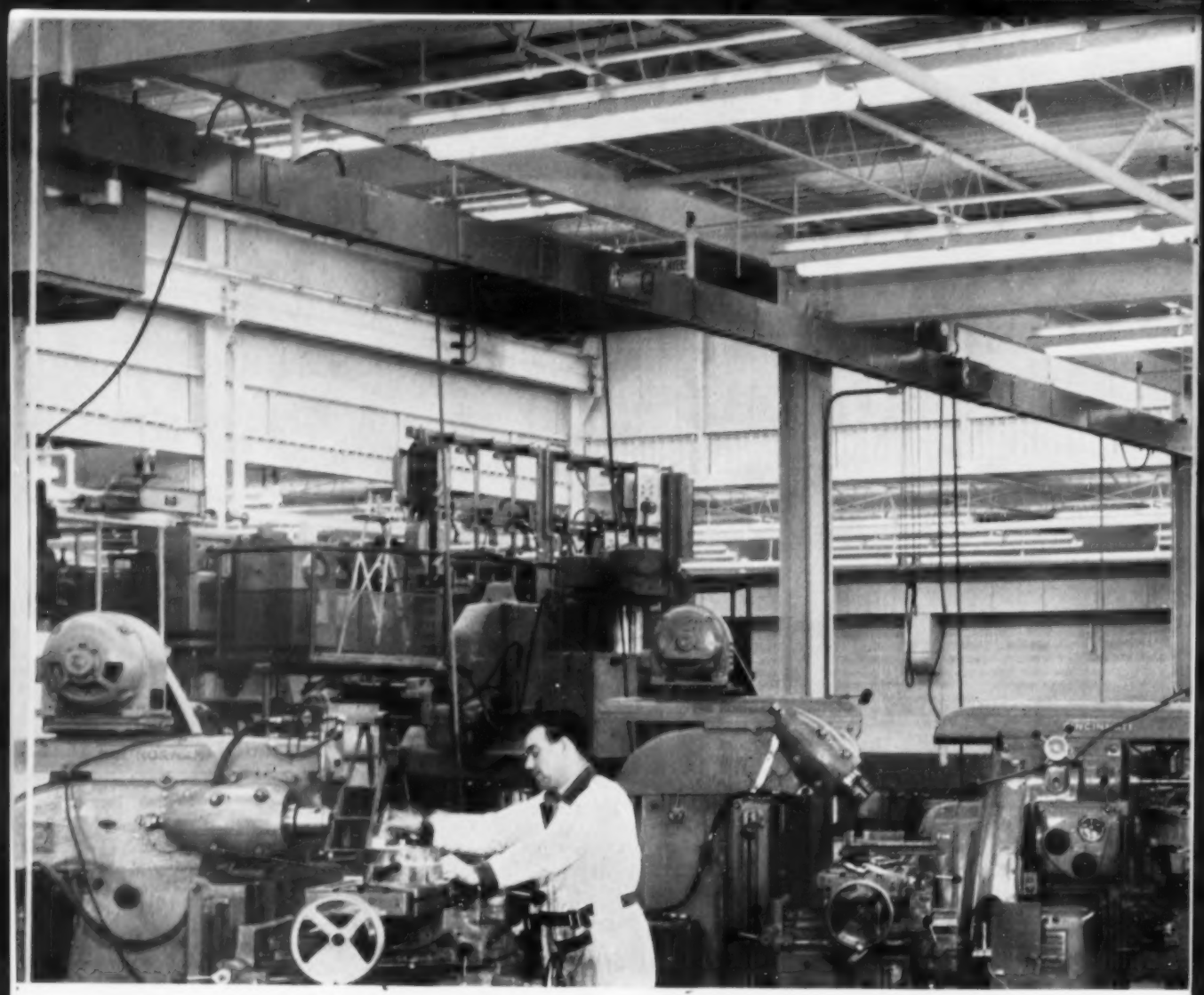

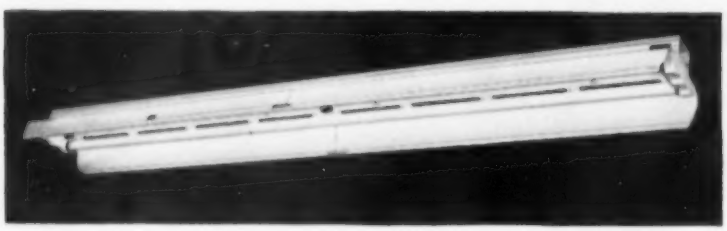

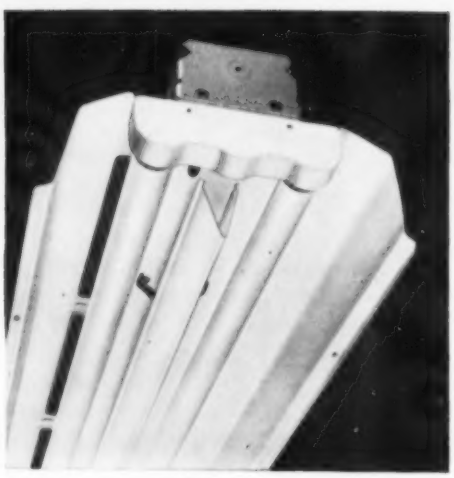

RLM fluorescents mean better efficiency in areas where effortless, accurate vision is essential. Fixtures stay clean longer . . . operate cooler due to air circulating through reflector apertures. And maintenance is minimized.

RLM's one-piece channel is lightweight, easy to handle. Easy-to-grip wing locks hold reflector firmly in place. No loose parts can be lost, no tools are needed for installing or reflector removal. Starter sockets are positively identified.

WATCH WESTINGHOUSE

RLM Fluorescents With 20% Up-Light Mean Faster, More Comfortable Vision

Over one-fifth of the light from Westinghouse RLM fluorescents is reflected upward. It literally bounces off the ceiling down to production areas adding extra—but now diffused—light. With higher illumination levels and better quality lighting, you'll notice an increase in acceptable production output.

With this lighting properly laid out to recommended foot-candle levels, production can change in type and scope, employee number can grow, and new machines can be added without making it necessary for you to add any more light to insure proper working conditions.

Westinghouse uses heavy-duty, steel-enclosed lamp holders for RLM's to make lamp replacement as simple as possible for you and eliminate the expense of breakage. Lightweight, completely wired channels, which permit fast installation, help lower initial costs.

Why not call the Westinghouse man listed in your area. He has more facts about lighting which are sure to help you. And you can be sure if it's Westinghouse. DP-5027-C

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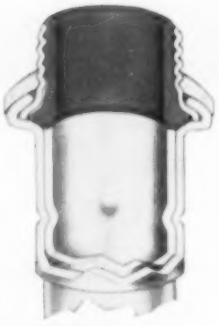
B-M INDENTER TYPE FITTINGS

FOR E.M.T. Concrete-tight

Red Throat
Insulated
Connector



Red Throat
Cross section

Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job.

All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.

GALVA • ILLINOIS

Warehouse Stocks in Principal Cities for Immediate Delivery!

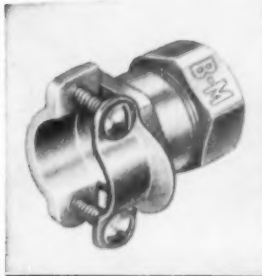
B-M COMPRESSION TYPE FITTINGS FOR E.M.T. Rain-tight

SIZES FROM ½" to 2"

SIZES FROM ½" to 2"

SIZES ½" ¾" 1"

SIZES ½" ¾" 1" 1¼"



SIZE ½"

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

LOBBY is generally illuminated to 37-fc intensity by means of Guth semi-recessed 4-lamp fixtures arranged in continuous rows on 8½-ft centers. This auditorium is becoming increasingly familiar to T-V viewers since many nationally televised sports events originate from this modern arena.

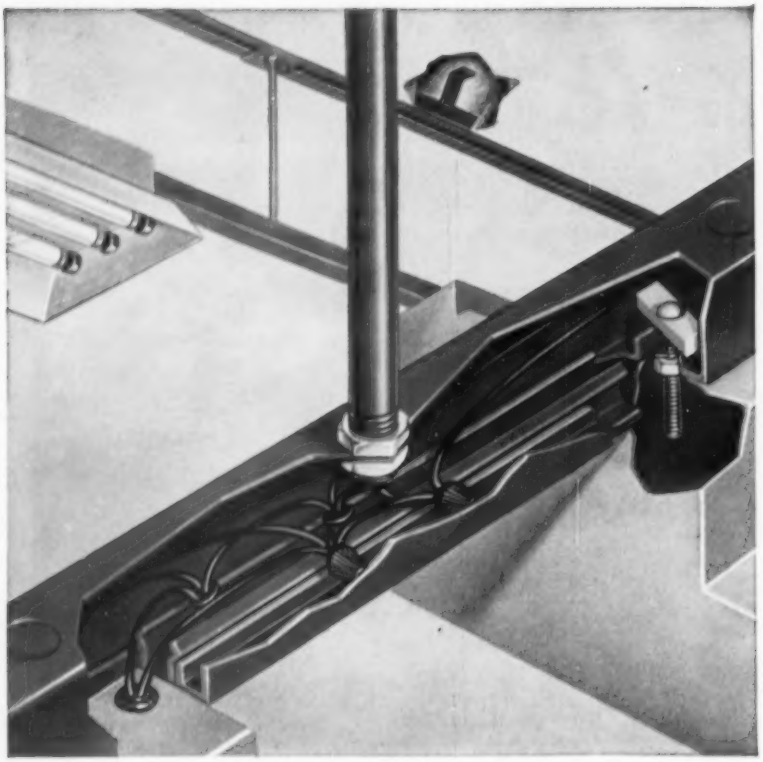
vide safe and free movement for lighting crews, but they also incorporate series of closely-spaced air conditioning and exhaust ports along lower edges—an arrangement resulting in mild, uniform movement of air, removal of tobacco smoke, and resultingly improved comfort and visibility for spectators and performers alike.

Beneath these galleries are luminous enclosing globe incandescent fixtures spaced on 19-ft centers (one per bay or section), thereby providing ample lighting for spectators to locate seats, read programs and plainly notice details of steps and aisles. Then, to provide reduced-level house lighting when that is desirable, there are 15 single 500-watt incandescent reflectors spaced across the roof on a 45-by-38-ft pattern.

When the auditorium is used for theatricals, conventions or events involving the use of the stage, three rows of border lights provide a basic illumination level of 20 fc for the 90-by-30-ft stage area, while additional lighting may be obtained in a variety of forms through the auxiliary use of spots, floods, tormenters and footstrips plugged into an array of conveniently located wall receptacles, floor boxes or overhead plug-in facilities. The stage is flanked by narrow gallery walkways and it is surmounted by catwalks so that stage crews may reach, position and operate all lighting and sound equipment, as well as shift scenery with maximum ease.

Above and in front of the stage is a bank of loud speakers, neatly housed and concealed by baffles and grille cloth, thereby providing a wide-coverage medium for making public announcements, disseminating high-fidelity transcribed programs from records or tape, or retransmitting commercial radio broadcasts to people assembled in the auditorium.

STAGE is basically lighted by three rows of border lights, while a wide assortment of outlets and plug-in facilities provide means for connecting additional flood and spotlights, footstrips, tormenters and special lighting effects. Galleries and catwalks permit stagehands to arrange, control and shift equipment with maximum ease and efficiency.



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CUTS YOUR LABOR COSTS: no skilled labor is required to MULT-A-FRAME. You get safe, strong fixture suspension quickly while keeping on-the-job labor cost to a minimum.

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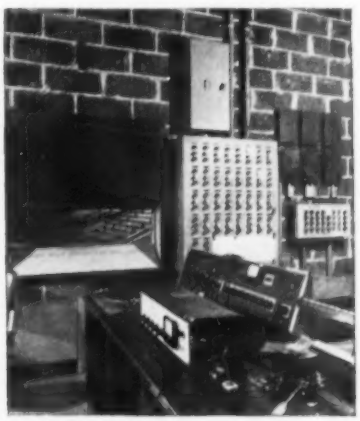
Control center for all lighting, air conditioning fans, stage effects and sound equipment is located at balcony level to the left of and behind the stage proscenium, a position from where the operating engineer can visually check activities and effects in the main auditorium (by looking through a viewing port in the intervening wall) or on the stage proper. A local phone system serves other key areas of the building.

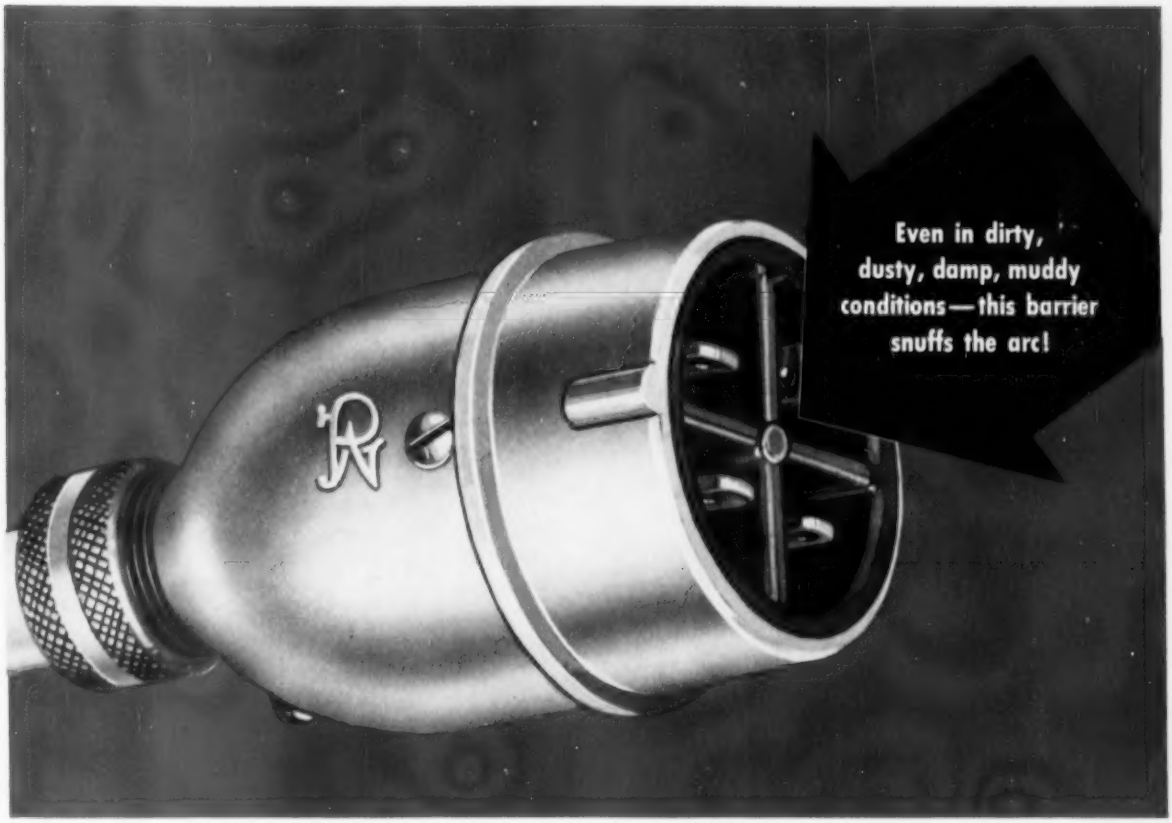
Color motif for auditorium walls and ceiling is light green, with gold stage curtains and multi-colored murals to add visual interest.

Entrance to the auditorium is through a main lobby which is illuminated to an intensity of 37-fc by means of Guth 4-lamp semi-recessed fluorescent fixtures. Lamps are shielded by curved plastic diffusing panels, and fixtures are mounted in continuous rows on 8½-ft centers. This area, approximately 2000 sq ft, has a 10-ft ceiling, is wall-tiled in light green, has a mottled tan terrazzo floor, and flat white acoustical-plaster ceiling.

All lighting and electrical details were designed by consultants Robson and Woese, and were installed by Salmon Electric, both firms being located in Syracuse. Since lighting treatments, air conditioning, public-address facilities, seating provisions and service arrangements for the public's comfort are all uniformly excellent, it is of little wonder that comments on all details are highly favorable.



CONTROL CENTER for all lighting, air conditioning fans, sound equipment and special effects is located at balcony level alongside stage proscenium. Viewing ports permit operating engineer to observe proceedings in auditorium or on stage, while communication with other key areas in the building is possible by means of local phone system.



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QuelArc isolates each pole in its own chamber—safe behind a phenolic barrier that effectively insulates contacts—even in the presence of mud, dampness, non-explosive dust.

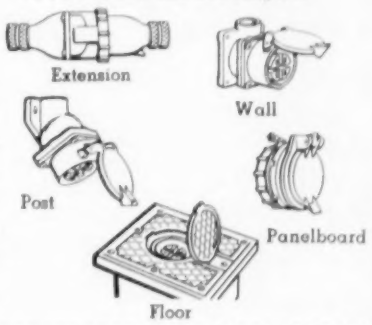
QuelArc has insulating paths several times longer than any other connector. Dirt or moisture accumulations won't affect their efficiency.

Double-action, Arc-Quenching effect is achieved by the design of QuelArc's tandem arc-snuffing chambers. QuelArc connectors may be coupled or uncoupled at full load with maximum safety.

IT COSTS NO MORE to be sure with QuelArc's extra precautions.

Write for QuelArc literature and information on other Pyle-National connectors in 8 lines for all environments.

QuelArc Current Rupturing Connectors
UL Listed—600 Volts AC, 250 Volts DC
20, 30, 60, 100 and 200 Amperes



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RIDGID

4-WHEEL

for easy cutting in tight places

RIDGID

Work-Saver Pipe Tools

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Artificial Daylight Speeds Growth of African Violets

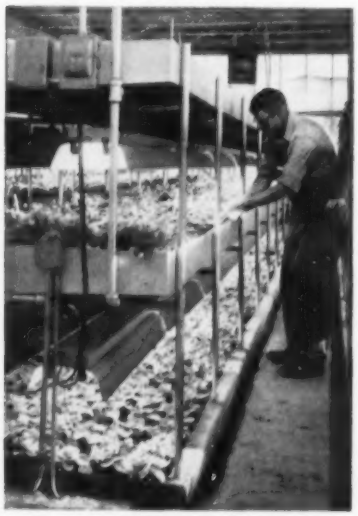
LIGHTING

That the growth of flowers and plants is stimulated by artificial illumination is verified by the experience of the Tonka-Dale Florists in Hopkins, Minn., where African Violets have been found to be especially responsive to this lighting approach.

Greenhouses located there are modern in every respect, with humidity and temperature constantly checked by hygrometer and thermostats, then regulated by sprinklers, unit heaters and fans.

Flats devoted to the growth of violets measure 4 ft in width and are tierred on welded pipe racks. Each flat is surmounted by two continuous rows of 2-lamp industrial RLM fixtures; lamps mounted therein being 40-watt daylight fluorescents positioned 12 to 15 in. above crowns of plants. Periods during which artificial illumination is maintained are exactly controlled by time clocks.

In all, 496 lamps are used in this installation, resulting in a connected electrical load of 25-kw. Since over 9,000 violet plants receive the benefit of this lighting installation, cost of current per plant is negligible; a hundred hours of light adding less than a cent to the cost of each potted flower.



GREEN GROW THE VIOLETS in this progressive greenhouse where continuous rows of daylight fluorescent lamps provide time-controlled artificial illumination for plants. Flats collectively hold over 9,000 plants, and installation involves lighting load of 25 kw, a current consumption that becomes negligible when reduced to a per-plant basis.

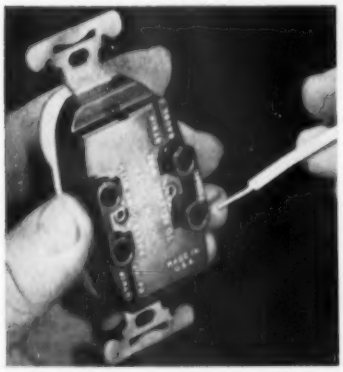
ADV.

NEW PRODUCTS

Demand for Weatherproof Devices on Increase

Today's trend toward outdoor living is causing an increased demand for weatherproof wiring devices. Therefore, Leviton has added a number of new weatherproof items to its line. These include single pole switches, and 3-way switches, single and duplex outlets with parallel blades, U-ground outlets, and 3-wire "crow's foot" outlets. Receptacles are available either with threaded metal covers or "spring-shut" hinged covers. Furnished with plate and heavy rubber gasket — proved protection for all-weather installations. Listed by U. L.

Leviton Expands Quickwire Series



T-slotted duplex receptacles, and single and duplex receptacles on covers are now a part of the growing line of QUICKWIRE devices. These "spring type", screwless terminal receptacles and switches make installation quick and easy. No screws to loosen and tighten, wire is stripped and inserted into hole. Permanent contact is assured by the exclusive Leviton coil spring connector. All QUICKWIRE items meet U. L. and C. S. A. specifications.

For complete information write Leviton Manufacturing Company, Brooklyn 22, New York.

LEVITON *brings you the best in wiring devices...*

TWO NEW DUPLEX SWITCHES

added to complete the **COMBINATION LINE**

These heavy duty switches are type C, T-rated: #5215, one single-pole and one 3-way switch in a single unit; #5217, two 3-way switches in a single unit. Both switches are independent of each other on the same circuit and designed to fit standard duplex wall plates. Sturdy construction with cover in either brown or ivory phenolic. Each rated 10A-125V-T, 5A-250V. Listed by U.L. and C.S.A. Meet R.E.A. and Federal specifications.

There is no finer line of combination wiring devices than the Leviton "5000" series. Now, with these two new switches, the "5000" series assures complete selection for every requirement.

Always specify LEVITON "5000" LINE for long, trouble-free performance:

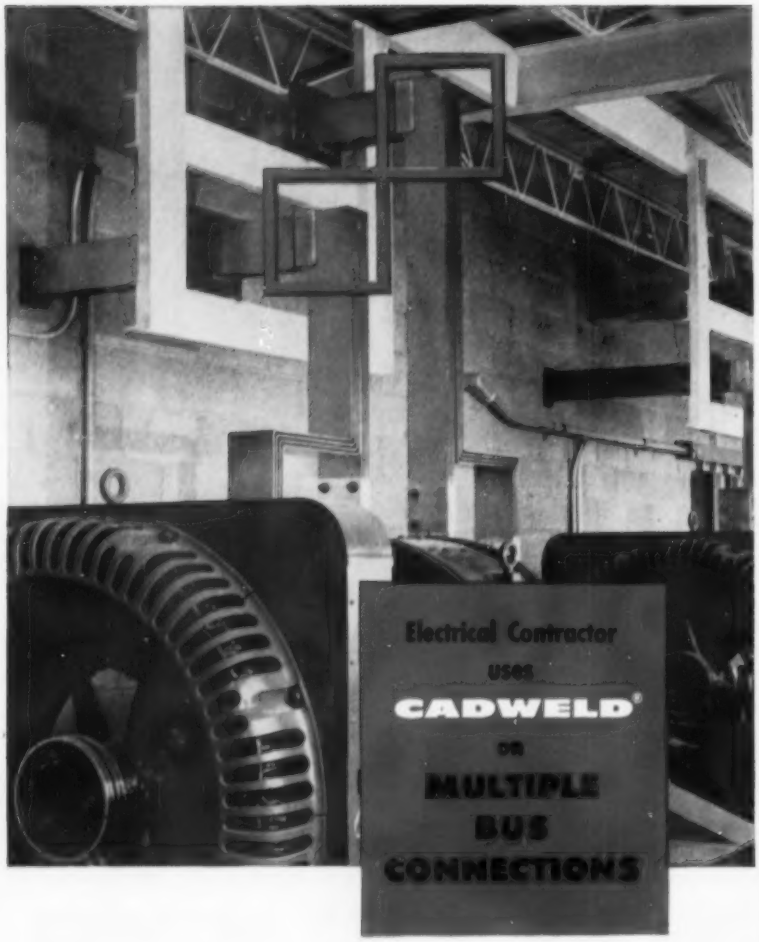
- #5000—T-Slotted Duplex Outlet
- #5001—Single Pole Switch
- #5211—Single Pole Switch & Outlet
- #5212—Duplex Single Pole Switches
- #5213—Single Pole Switch & Pilot Light
- #5214—Duplex Switches—Separate Circuits
- #5215—Single Pole & 3-way Switch
- #5217—Two 3-way Switches

your best jobs are done with ...**LEVITON**

LEVITON MANUFACTURING COMPANY • BROOKLYN 22, N. Y.

Chicago — Los Angeles — Leviton (Canada) Limited, Montreal

For Best Results Use Wire By AMERICAN INSULATED WIRE CORPORATION



Carlson Electric Co., Youngstown, Ohio used CADWELD Electrical Connections on three large multiple bus installations during 1955.

According to Mr. William P. Burkey, Carlson's Chief Engineer;

1. **CADWELD Connections reduce the labor cost.**
2. **CADWELD Connections result in a superior electrical installation that cannot loosen or corrode and is maintenance free.**

Jobs involved various sizes and number of bus, ranging from a splice of ¼" x 2" bus up to a splice of eight ¼" x 6" bus.

Before figuring your next bus installation, investigate **CADWELD.**

CADWELD®

Erico Products, Inc.

2070 E. 61st Place · Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

30 Footcandles For Manufacturing

LIGHTING

Twin reflector assemblies, combining incandescent and mercury vapor lighting, are mounted on a 20-by-20-ft plan in the Clark Equipment Company's new Pipestone Road Construction Machinery plant at Benton Harbor, Mich. Units are suspended level with the lower chords of roof trusses, placing the fixtures 25 ft above the working plane where illumination exceeds an average of 30 footcandles.

Designed by The Austin Company, the plant also has nine overhead bridge cranes (with capacities ranging up to 10 tons), many free-standing mechanized jib cranes, plus monorail hoisting rigs in local areas. Unit heaters, thermostatically controlled, further contribute to this modern manufacturing plant where production aisles measure a liberal 60 ft in width, and where structural columns are nowhere spaced closer than 40 ft apart.

MERCURY-INCANDESCENT twin-reflector units provide 30-plus footcandles to working floor in this modern plant equipped with extensive power distribution system, conditioned air and wide assortment of materials-handling cranes and hoists.

Fire Protection For Pole Lines

PREVENTION

Brush fires have long been a principal source of damage to wooden pole lines. Power companies expend untold thousands of dollars each year attempting to control the

Why a million Amprobes save hours on the job!

The Amprobe snap-around volt-ammeter (circled above) measures voltage and current instantly, accurately, safely. This pocket-size tool saves *your* valuable time on the job while ...production equipment keeps right on rolling. You get to the heart of the problem—eliminate guesswork—save production employees valuable time on *their* jobs.

One million Amprobes in use today make Amprobe the standard snap-around tester of the industry. There's an Amprobe for every job, every budget: from 10 amp and 250 volts to 1200 amp and 600 volts AC; from $19.85 to $67.50.

AMPROBE a division of Pyramid Instrument Corp., Lynbrook, N. Y.
world's most popular snap-around volt-ammeter

MAIL FOR FREE SERVICE BOOKLETS

Pyramid Instrument Corp., Dept. M-76, Lynbrook, N. Y.
Please send me the Amprobe service bulletins checked below

- ☐ How to cut costs and land more jobs
- ☐ How to boost your service profits
- ☐ Trouble-shooting electric motors
- ☐ Electrical serving of hermetic units

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ALUMINUM
OR GALVANIZED STEEL
SUPPORT SYSTEMS
FOR POWER AND CONTROL CABLES
IN-FREE-AIR
DESIGNED AND DEVELOPED BY HUSKY PRODUCTS

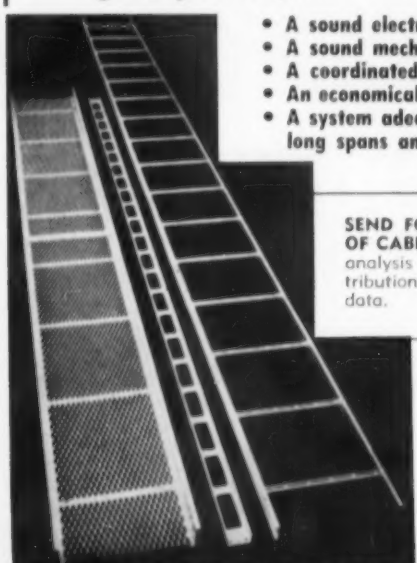
Engineers Please remember— these famous words:—

"There is hardly anything in this world that some man cannot make a little cheaper—and a little worse. . ."

Specify:

HUSKY
OR APPROVED EQUAL

and be certain that YOUR approval gives your client:



- A sound electrical system.
- A sound mechanical system.
- A coordinated system with unit responsibility.
- An economical job—the lowest "Installed Cost."
- A system adequate for indoor or outdoors, for long spans and ideal for future expansion.

SEND FOR YOUR COPY OF "THE STORY OF CABLE IN FREE AIR". A comprehensive analysis of the modern trend in power distribution with photographs and economic data.

THE HUSKY SUPPORT SYSTEM—the only cable support system approved and recommended by all major cable manufacturers.

AVAILABLE THROUGH LEADING CABLE MANUFACTURERS

HUSKY PRODUCTS, INC.
5300 VINE STREET, CINCINNATI 17, OHIO

growth of high grass and brush along their lines. Despite their best efforts, however, effective control of undergrowth is virtually impossible in certain areas.

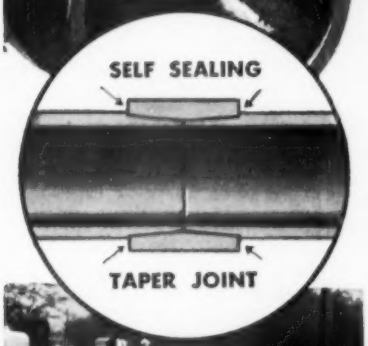
Such a condition existed with a transmission line running through a lowland section adjacent to the Minnesota River in southern Minnesota. Heavy moisture of this semi-bog promoted rapid growth of tall grass and weeds and, at the same time, restricted the passage of mowing machines.

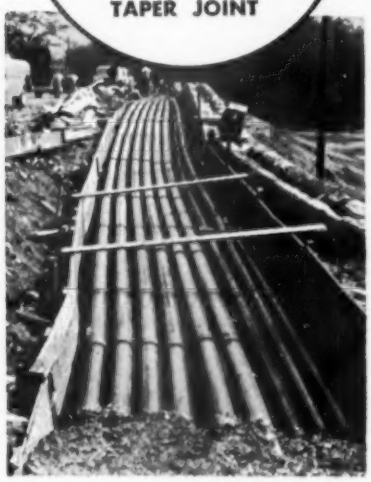
The poles on this line are each supported by three pilings arranged about the pole and driven into the ground to depths up to 50 ft. Approximately 15 ft of each piling remains above ground. These stubs are individually secured to the pole. Brush fires represent a particularly strong hazard to this installation, both on account of the high grass and because the creosoted pilings could be quickly ignited, even by flash fires.

Lasting protection from this source of damage was obtained by covering the pilings with aluminum to a height of 12 ft above ground. Sheets measuring 4 by 12 ft and 0.032-in. in thickness were wrapped around the pilings and secured with spiral-shanked aluminum roofing nails with neoprene washers. This lightweight, easy-to-install technique affords a durable safeguard against fires with only a slight increase in construction cost and a big reduction in maintenance.

LARGE RACEWAYS for telephone circuits servicing the New York Coliseum were terminated in electrical closets about 2 ft above the distribution cabinets. To eliminate the necessity of making a great number of difficult and time-consuming offsets in the rigid pipe, connection was made to distribution cabinet by means of flexible metallic conduit. Electrical contractors were T. Frederick Jackson, Inc. and J. Livingston & Co., of New York.

SMOOTH BORE!





Orangeburg Fibre Conduit Prolongs Cable Life

Protect cable sheath from abrasion and you prolong the life of underground cables, say utility engineers. Scoring of cable sheath creates "trouble spots" that shorten cable life.

That's where Orangeburg Fibre Conduit plays an important part in keeping cables healthy. Orangeburg's smooth bore, its low coefficient of friction minimize the danger of abrasion when cables are pulled in, as well as later on during cable movement. By protecting cable sheath from abrasion, Orangeburg Fibre Conduit adds years to cable life.

Orangeburg's impermeable wall and watertight joints protect cables from corrosive ground waters. Its nonmetallic material is strong, tough, resilient, long lasting.

And, remember, Orangeburg lays faster and at lower cost than other types of conduit. It is light in weight, easy to handle, easy to tool on the job. Spacers, bends, fittings, 5° bend sections and lightweight tapering tool, all combine to simplify installation.

Since 1893, records of long life have proved Orangeburg's durability and economy.

Orangeburg Fibre Conduit is distributed by Graybar Electric Company and General Electric Supply Company with branches and stocks in principal cities.

WRITE DEPT. EC-76 FOR NEW CATALOG 52.

ORANGEBURG MANUFACTURING CO., INC., Orangeburg, N. Y. West Coast Plant, Newark, Calif.

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FIBRE CONDUIT

Smooth "Pulley Action" Wireway Prevents Conductor Chafing
Extra-Sturdy Solid Rivet
Large 1" x 7/8" Hole
Heavy Steel Cup-Base and Yoke—A Single Hot Dipped Galvanized Steel Stamping
Two Holes In Base Assure Effective Drainage
No. 22 x 2¼" Hot Dipped Galvanized Screw Assembled Solidly and Rigidly to Steel Base
Extra Sharp Threads and Quick-Starting Point Make Driving Easy

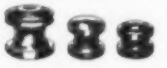
Now packed in handy carrying carton

RUGGED DURABLE DEPENDABLE

PORCELAIN PRODUCTS

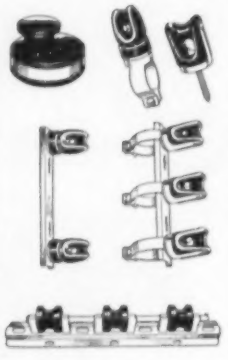
WIREHOLDERS

AND SECONDARY SERVICE MATERIALS



Where *quality* and *performance* are necessary for continuous line service—Porcelain Products wireholders and secondary service materials *assure* reliability. They're engineered with strong, sturdy construction—metal in tension, porcelain in compression. Steel parts are hot-dip galvanized . . . screw threads are extra sharp, lubricated for ease of installation. Larger, pulley-action wire hole, for large wire sizes—prevents chafing, wire wear.

These EXTRA features—*plus*—Porcelain Products "Quality Line" reputation, make an unbeatable combination . . . SPECIFY PORCELAIN PRODUCTS wireholders and secondary service materials.



62 Years **Porcelain Products, Inc.** PP INC.
FINDLAY, OHIO

WHAT'S THE LAW?

By Jack and Michael Strauss

QUESTION: Is an "Unconditional Guaranty" absolute protection?

Otto was given a one year "Unconditional Guaranty" when he had the Jones Company wire and install an air conditioning system in his department store. Under the terms of the guaranty, the Jones Company agreed to remedy any and all defects found or requiring correction in the system within that one-year period.

Two months after the installation, however, it developed that the department store owner would have done better to have ordered row boats instead of air conditioning. His nemesis wasn't a heat wave but a series of severe rain storms that completely flooded his basement and submerged the electric motors that operated his newly installed air conditioning system.

Frantically, Otto called in the Jones Company to repair the system. When the work was completed, he was surprised to receive a bill for the work done.

"You gave me an 'Unconditional Guaranty' on the equipment", he complained. "That means you've got to fix anything and everything that happens to my unit . . . free of charge . . . for the life of the guaranty."

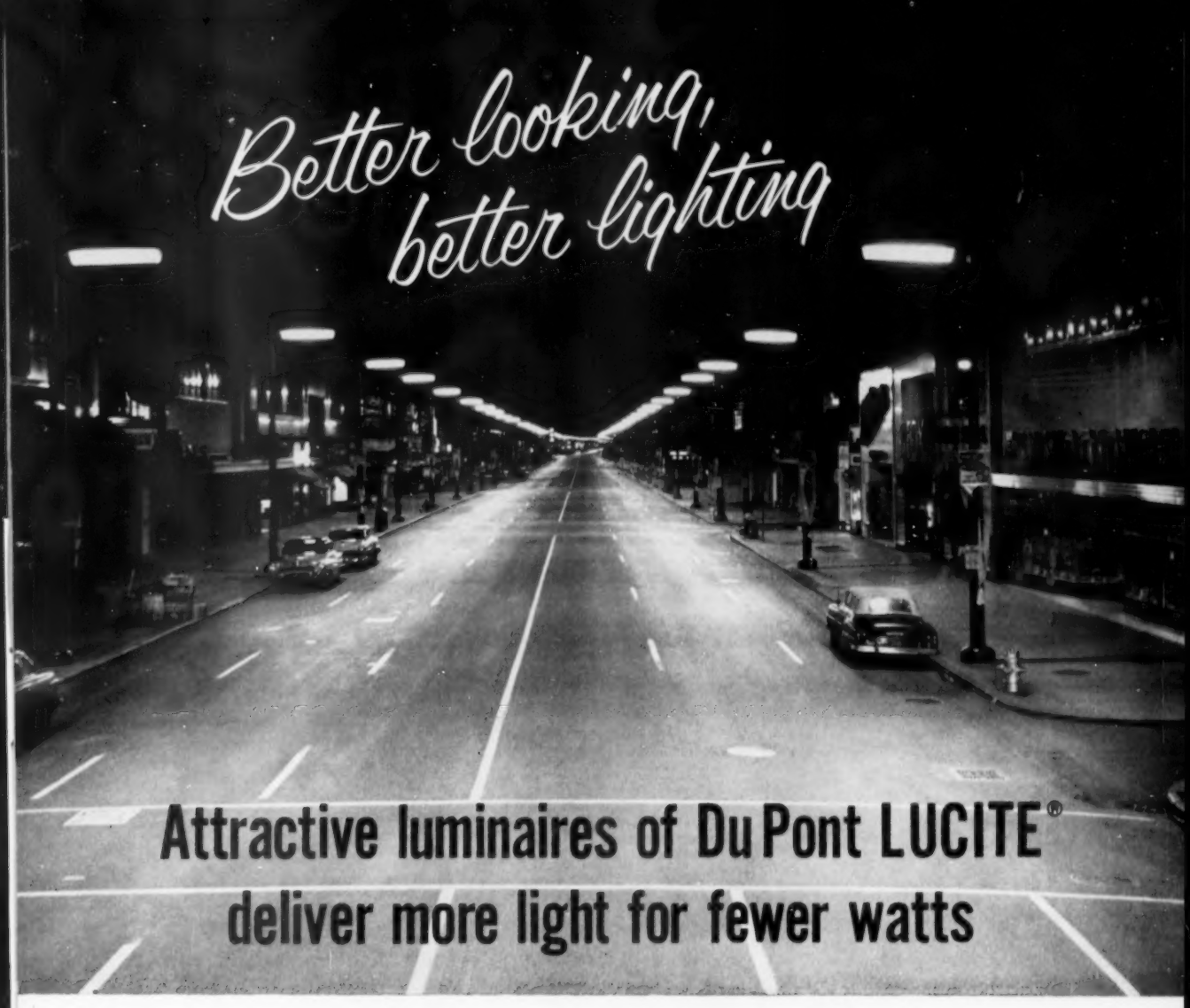
"Let's be reasonable", Mr. Jones answered. "The 'Unconditional Guaranty' was only intended to cover defects in workmanship or materials . . . not damages caused by a flood."

Otto, however, refused to be "reasonable" and Mr. Jones was forced to sue to collect his bill.

THIS WAS THE DECISION: The Court held for Mr. Jones. It said where a word in a contract is so broad as to include an uncontemplated event, the parties to the contract are not bound by that word if the uncontemplated event occurs.

In this case, concluded the court, since we believe that neither Otto nor Mr. Jones contemplated that the air conditioning system would operate under water, Mr. Jones' guaranty did not make him responsible to repair the damage caused to the air conditioning system by the flood.

(Based upon a 1950 Texas Decision. State laws vary. For personal guidance, see your local attorney.)



Attractive luminaires of Du Pont LUCITE® deliver more light for fewer watts

These modern luminaires, utilizing LUCITE acrylic resin extruded by Southern Plastics Corporation, Columbia, South Carolina, are bringing more effective lighting to Euclid Avenue in downtown Cleveland . . . and doing so at reduced operating expense.

Fixtures formerly used on Euclid Avenue had two 1,000-watt lamps, dispensing 40,000 lumens. However, because there was a 50 per cent wastage, light on the street was only .7 foot-candles.

With the new luminaires, supplied by Westinghouse Electric Corporation, Cleveland, Ohio, the bulk of the 21,400 lumens from four 100-watt fluorescent tubes is directed downward, giving 1.67 foot-candles of light on the street. The new luminaires at a calculated consumption of only 256,000 kilowatt-hours per year will give more than twice the street illumination of the old lamps, which required 1,024,000 kilowatt-hours per year.

The Euclid Avenue installation represents a total investment of $55,000. The saving effected from lower maintenance and reduced use of electrical energy will amount to about $5,000 annually.

Du Pont LUCITE offers long-lasting beauty, clarity and unique light-transmission properties in all types of modern lighting installations—modular light-diffusing panels, large-area lighting, lenses for troffer and pendant luminaires, side panels and protective elements for outdoor fixtures. For complete information without obligation on how you can profit by including Du Pont LUCITE in your lighting plans, send for the free booklet, "Better Lighting with Du Pont LUCITE". Write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 447, Wilmington 98, Delaware.

• This "Quality Controlled" label may be used only by qualified extruders of Du Pont LUCITE acrylic resin. It assures the lighting industry that the extruded material conforms to standards for low shrinkage and uniform caliper established by E. I. du Pont de Nemours & Co. (Inc.).

Quality Controlled

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BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

347 Local General Electric Distributors Announce . . .

"OFF-THE-SHELF" DELIVERY OF G-E

NOW—347 G-E motor Distributors throughout the country have increased their stocks to give motor buyers faster delivery of G-E Tri-Clad* '55' motors. They now carry a complete line of Tri-Clad motors—listed at right—to keep your down time at a minimum and to help cut your standby inventory. Dial your local G-E Distributor today. His name and phone number are listed on the following pages. Call him now and he'll send you a handy Tel-Eze phone index—FREE.

*Registered trademark of General Electric Co.

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FREE GIFT! Call your local G-E motor Distributor to learn how you get faster delivery on Tri-Clad '55' motors 5 to 20 hp and larger. He'll also send you this handsome Tel-Eze phone index as a gift. Fasten it right to your phone. It's handy—useful—never in the way. (Supplies limited—call today.)

MOTORS 5 TO 20 HP

LISTED DISTRIBUTORS STOCK THESE MOTORS AND OTHERS IN SMALLER AND LARGER SIZES

HP	RPM	ENCLOSURE	HP	RPM	ENCLOSURE
5	1200	Drippproof	10	1800	Enclosed
5	1200	Enclosed	15	1800	Drippproof
7½	1800	Drippproof	15	1800	Enclosed
7½	1800	Enclosed	20	1800	Drippproof
10	1800	Drippproof	20	1800	Enclosed

All motors are standard, 208-220/440-volt, 60-cycle, 3-phase, Type K, ball-bearing models.

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BURLINGTON
Crescent Elec. Supply Co.
F. J. Hemann, PL 2-3631
CEDAR RAPIDS
Crescent Elec. Supply Co.
Leo Plotz, 3-9601
DAVENPORT
Crescent Elec. Supply Co.
George Mittman, 3-1811
Graybar Elec. Co., Inc.
R. J. Nelson, 3-2767
DES MOINES
Elec. Engrg. & Equip. Co.
L. E. Morse, AT 2-0431
General Elec. Supply Co.
C. B. (Barney) Peek, AT 8-7401
DUBUQUE
Crescent Elec. Supply Co.
Francis McDonough, 3-6411
WATERLOO
Crescent Elec. Supply Co.
James D. Martin, Adams 4-6866

KANSAS
PITTSBURG
Atkinson Armature Works
Frank Horton, 1754
WICHITA
General Elec. Supply Co.
Jim Owens, AM 5-0627

KENTUCKY
HARLAN
General Elec. Supply Co.
Bud Thompson, 815
LEXINGTON
General Elec. Supply Co.
Paul E. Hines, 2-1887
Graybar Elec. Co., Inc.
L. W. Wester, 5-2020
LOTHAIR
Mine Service Co.
Phone 239
LOUISVILLE
General Elec. Supply Co.
Jack Mattingly, ME 7-3651
Graybar Elec. Co., Inc.
C. J. Honadle, Melrose 7-5411
Marine Elec. Company
Melvin Theobald, Juniper 4-7175

LOUISIANA
ALEXANDRIA
Brown Roberts Elec. Co.
Mack King, 3-7281
BATON ROUGE
General Elec. Supply Co.
G. F. Shilling, 7-7586
NEW ORLEANS
General Elec. Supply Co.
Harvey Wager, Galvez 5771
Graybar Elec. Co.
John Palmer, Canal 6263
New Orleans Armature
John Berger, Canal 9566
Standard Supply & Hardware Co.
A. W. Herbert, CA 6641
SHREVEPORT
General Elec. Supply Co.
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J. L. Roberson, 5-3271

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WESTBROOK
Stultz Elec. Works
Robert Webb, UL 4-2501

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George Milligan, KE 6-4567
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Robert L. Sandman, HI 2-7600
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Des Roberts Elec. Supply Co.
G. W. Knowlton, Lynn 5-0015
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Francis Cross, Pleasant 6-4351

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Victor L. Kochajda, LO 8-9092
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O. C. Hall, TR 5-9400
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JACKSON
Elec. Wholesale Supply Co.
P. Spry, 2-7123
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G. E. Herrington, 3-2645
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Barker-Fowler Elec. Co.
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J. H. Gallagher, Ivanhoe 7-5401
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M. Pratt, IV 7-5075
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Fitzpatrick Electric Supply Co.
2-6621
SAGINAW
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Bob Borg, FE 8-7531
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E. H. McQuire, FE 2-4571
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R. Woods, MI 5-2761

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J. P. Hutchinson, 5-8361

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General Elec. Supply Co.
Harold Burrows, HA 1-7447
ST. LOUIS
General Elec. Supply Co.
Walter Euler, JE 1-3000
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Wayne Aceto, JE 1-4700

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BILLINGS
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BUTTE
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Dick Murtha, 3233

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OMAHA
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Schneider Elec. & Equip. Co.
W. J. Andersen, Webster 5550

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RENO
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W. R. Reynolds, Reno 3-3729

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MANCHESTER
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Joe Charron, NA 5-5418

GENERAL ELECTRIC

SHELF" DELIVERY OF G-E MOTORS 5 TO 20 HP

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National Elec. Supply Co.
Meyer Borstein, Emerson 5-4330
NEWARK
General Electrical Equip. Co., Inc.
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General Elec. Supply Co.
Bill Lutton, BI 2-1600
Graybar Elec. Co., Inc.
M. Pearce, MA 2-5100
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A. Bishop Elec. Motor Exchange
Arnold Bishop, KI 5-6446
PATERSON
General Elec. Supply Co.
G. Weindling, LA 5-5100
Reliable Elec. Motor Repair Co.
Harold Muller, AR 4-7756
Watson-Flagg Sales Corp.
E. M. Koetsier, LA 5-2324
TRENTON
General Elec. Supply Co.
Ray Jamieson, Owen 5-3453
Thropp Elec. Sales Corp.
C. W. Archinal, JU 7-1441

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4-6016
Electric Service, Inc.
2-9447
General Elec. Supply Corp.
2-5246

NEW YORK
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Graybar Electric Co., Inc.
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Havens Electric Co., Inc.
5-1201
BUFFALO
General Electric Supply Co.
R. H. Sheldon, EL-5100
Graybar Electric Co., Inc.
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John F. Decker, 6163
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Glens Falls Electric Supply Co., Inc.
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Central Queens Elec. Supply Corp.
Charles Weltner, RE 9-2020
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L. H. Kort, EX 2-2000
Motors & Armatures, Inc.
Sid Davis, EX 2-3523
NEW YORK
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M. Goldberg, CA 6-4665
General Elec. Supply Co.
Jim Boyland, AL 5-3300
W. W. Grainger, Inc.
E. Heckler, CA 6-3810
Hudson Elec. Sales Co., Inc.
D. Hark, WO 2-3041
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Electra Supply Co., Inc.
Howard K. Phillips, 8000
ROCHESTER
Electric Equip. Co. Div.
Norry Elec. Company
GL-6070
General Elec. Supply Co.
Dan Nolan, HA 7500
T. H. Green Electric Co.
HA-9840
SYRACUSE
M. H. Salmon Elec. Co., Inc.
R. S. Bowser, 73-3325
TROY
Tri-State Elec. Motors, Inc.
D. W. Fitzpatrick, Ashley 2-4250
UTICA
Langden & Hughes Elec. Co., Inc.
C. A. Dyer, 4-3154
Mather, Evans & Diehl Co., Inc.
Bill Diehl, 4-6165

NORTH CAROLINA
ASHEVILLE
General Elec. Supply Co.
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CHARLOTTE
Armature Winding Co.
J. E. Jenkins, ED 3-2158
General Elec. Supply Co.
J. B. Hurt, Jr., FR 5-7321
Mill-Power Supply Co.
B. M. Foster, Franklin 5-5761
FAYETTEVILLE
General Elec. Supply Co.
T. C. Merritt, 2-5143
GREENSBORO
General Elec. Supply Co.
John F. Alexander, 3-8207
GREENVILLE
General Elec. Supply Co.
Bob Prevatte, 5104
LAURINBURG
Electrical Equip. Co.
H. A. Gill, 1196
RALEIGH
Electrical Equipment Co.
W. T. Becton, TE 2-2039
General Elec. Supply Co.
C. T. Parks, TE 3-4691
WINSTON-SALEM
Graybar Elec. Co., Inc.
D. W. Terry, 4-2461

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Graybar Electric Co., Inc.
Robert Bender, JE 5-4143
CANTON
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Dean Ray, GL 4-5187
Jackson-Bayley Electric Co.
W. Bayley, Jr., GL 5-9421
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GA 1-1750
Graybar Elec. Co., Inc.
MA 1-0600
CLEVELAND
Elliott Electric Co.
F. G. Allan, TO 1-2454
General Elec. Supply Co.
Len Burns, HE 1-7280
Graybar Electric Co., Inc.
G. W. MacCarter, HE 2-2500
Strong, Carlisle & Hammond Co.
Jim Simmons, TO 1-8800

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Marion Klocki, AX 9-1142
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MI 0781
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TW 4-8128
PORTSMOUTH
General Elec. Supply Co.
3-2341
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General Elec. Supply Co.
L. J. Cole, Cherry 4-8661
Graybar Elec. Co., Inc.
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YOUNGSTOWN
Economy Electric
E. Cutler, Jr., Riverside 4-4461
General Electric Supply Co.
C. B. Monroe, Riverside 6-6511
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OKLAHOMA CITY
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TULSA
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F. G. Ross, DI 3-6121
Graybar Elec. Co.
Ray Downing, MA 6-2121
WEWOKA
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U. E. Richter, Congress 7-6319
EUGENE
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R. E. Yates, Diamond 5-0373
KLAMATH FALLS
Klamath Mach. Co.
H. Ellis, 2-2588
MEDFORD
American Steel & Supply, Inc.
R. S. Rix, 2-7181
General Elec. Supply Co.
P. Jorgenson, 3-4519
PORTLAND
Eoff Electric Co.
CA 2-9411
General Elec. Supply Co.
CA 7-0651
Graybar Elec. Co., Inc.
CA 7-6641
Holt & O'Donnell
CA 8-0753
ROSEBURG
Industrial Elec. Service Co.
L. Hobart, OR 3-6658

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ALLENTOWN
Allen Elec. Co.
L. Brown, HE 5-9515
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Bob Harte, Hemlock 3-5206
BRADFORD
Bovaird & Co.
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F. Robinson, CL 9-6440
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Al Weirich, 2-1477
INDIANA
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JOHNSTOWN
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G. E. Brown, 7-6221
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P. D. Chick, WA 2-5405
Jos. T. Fewkes & Co.
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Bill Rodgers, Reading 4-2169
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H. McDowell, Diamond 4-8563
Scranton Elec. Construction Co.
A. W. Winter, DI 2-3152
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Globe Elec. Repair Co.
Steve Marshall, Sterling 1-2677
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Westchester Elec. Supply Co.
R. McLaughlin, WE 4722
WILLIAMSPORT
Lowry Electric Co., Inc.
P. M. Griffin, 2-7841
WILKES-BARRE
General Elec. Supply Co.
H. G. Holland, Valley 2-5106

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W. L. Higgins, GA 1-6523
J & H Electric Co.
Calvin Wilcox, GA 1-7840
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Pawtuckett 5-7400

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ANDERSON
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Sumter Machinery Co.
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ABERDEEN
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Don Lohr, 4911
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T. R. Hersey, FI 2-7913

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CHATTANOOGA
Elec. Motor Sales & Supply Co.
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Graybar Elec. Co., Inc.
Max Evans, 4-3351
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Middle Tenn. Armature Wks.
R. Cleveland, EV 8-3672
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Graybar Elec. Co., Inc.
Jim Branson, BR 8-7150
Tri-State Armature & Elec. Wks.
W. W. Bumpus, JA 7-8414
NASHVILLE
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N. G. Welch, ALpine 4-3508
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ABILENE
General Elec. Supply Corp.
Ray Alexander, 2-2827
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Buck Buchanan, 2-2861
AMARILLO
General Elec. Supply Co.
B. D. Garrett, DR 6-7254
Graybar Electric Co., Inc.
G. N. Barker, DR 2-6778
BEAUMONT
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Arlan Young, 4-6435
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Bradley Motor & Armature Works
Ernest B. Williamson, TU 2-8891
General Elec. Supply Co.
W. D. Clarke, TU 2-9237
Graybar Elec. Co., Inc.
M. J. Smith, TU 4-6374
DALLAS
General Elec. Supply Co.
Ollis W. Walden, RA-2201
Graybar Elec. Co., Inc.
Jerry Foster, RA 6452
W. M. Smith Elec. Co.
Gene Jackson, Hamilton 8-4606
EL PASO
General Elec. Supply Co.
Joe Caldwell, 3-3407
Graybar Elec. Co., Inc.
H. Chaparro, 3-7561
FT. WORTH
General Elec. Supply Co.
Paul Huntley, ED 2-5385
Graybar Elec. Co., Inc.
Bill Hart, ED 5-4523
HOUSTON
Buffalo Elec. Co.
Chuck, Sonny, or Andy, CA 8-4431
General Elec. Supply Co.
T. W. Haley, FA 3-3121
Graybar Elec. Co., Inc.
Tom Keen, CA 8-4571
Oliver Armature Works
Thurman Tedder, CA 2-9271
LUBBOCK
General Elec. Supply Co.
Allen Pistole, PO 3-8271

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GENERAL ELECTRIC

"OFF-THE-SHELF" DELIVERY OF G-E MOTORS 5 TO 20 HP

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San Antonio Machine & Supply Co.
S. V. Patrick, CA 5-1651
General Elec. Supply Co.
J. A. Russell, CA 7-1261
TYLER
General Elec. Supply Co.
R. A. Hamilton, 2-1674
WACO
General Elec. Supply Co.
Henry L. Fleischhauer, 2-1611
WICHITA FALLS
Elec. Motor Co.
Eugene Phillips, 7-7841

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Elgin 9-8771
Refrigeration Distributors Corp.
DA 2-5886

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Electrical Equip. Co.
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W. E. Sheppard, MA 2-7183
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J. W. Hughes, 3-1364
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General Elec. Supply Co.
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TACOMA
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Bluefield Supply Co.
W. E. McDougle, DA 5-6131
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Virginian Electric, Inc.
W. H. Knight, 6-0631
HUNTINGTON
Virginian Electric, Inc.
L. E. Pauley, 2-8396
LOGAN
Logan Hardware & Supply Co.
J. P. Swindell, 710
WHEELING
General Elec. Supply Co.
R. L. Nickerson, 2555

WISCONSIN
APPLETON
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W. Van Weele, RE 4-7155
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H. H. Beemster, HE 7-3238
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Crescent Elec. Supply Co.
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L. E. (Bud) Tapp, Broadway 6-7730
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R. R. Schober, BR 6-8400
WAUSAU
Snapp Elec. Supply Co.
R. C. Runquist, 2-1031

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CASPER
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K. R. Brown, 2-7333
CHEYENNE
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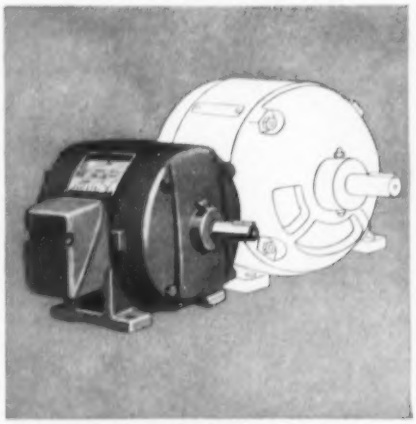
TERRITORY OF HAWAII
HONOLULU
American Factors, Ltd.
Ken Asari, 5-1511

What's Your Motor Problem?



NEED A MORE COMPACT MOTOR? . . .

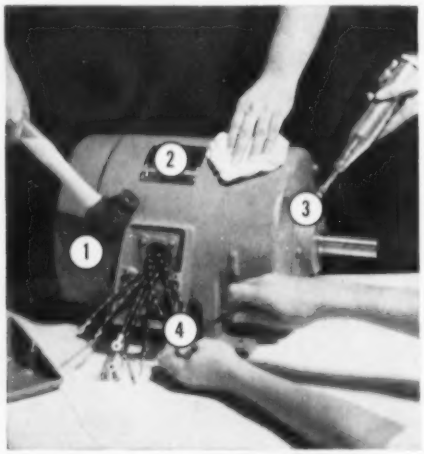
Excess bulk has been trimmed and all wasted space eliminated from TRI-CLAD '55' Motors. Some are up to one-third more compact!

ONE THAT WATER WON'T FAZE? . . .

New miracle materials in the TRI-CLAD '55' insulation system make it shed water like a duck's back!

AND 60% GREATER PROTECTION? . . .

New enclosure on the TRI-CLAD* '55' (above) guards it against dirt, dust and moisture *far better* than old-style motors!



WITH MUCH EASIER MAINTENANCE? . . .

(1) Man-size knock-off lugs, (2) stainless steel nameplate, (3) provision for regreasing on the job, (4) permanently numbered leads.

*Registered trademark of General Electric Co.

For more information on the new, fast-service plan—and "special" G-E Tri-Clad motors—call your local G-E motor Distributor.

MEDIUM INDUCTION MOTOR DEPARTMENT
GENERAL ELECTRIC COMPANY, SCHENECTADY 5, N. Y.

GENERAL ELECTRIC

Motor Shops

SMALL PARTS and tools are kept off work surface yet conveniently within reach of workers in this Camden, N. J., motor repair shop. Local lighting is provided by separate 2-lamp fluorescent fixtures located directly above each work bench.

Shop Stresses Convenient Storage and Good Local Lighting

Small parts and hand tools are conveniently stored above each work bench in the shop of Milton Eisenhardt, near Camden, N. J., thereby placing these items within convenient reach of each worker, yet keeping them off actual working surfaces.

The open metal bins used to hold small parts are slanted forward, thereby permitting workers to visually spot all stocked items. Bottom, front corners of bins are rounded to make it easier for workers to slide required items from their respective storage compartments.

Depending upon size and shape of tools, they are variously retained by hooks, open- or closed-bottom racks, or lipped shelves.

Benches are also equipped with steel-jawed vises, wire reel racks, twine spindles and other essential facilities, while good local seeing conditions are created for each worker by locating a separate 2-lamp 40-watt industrial fluorescent reflector above each work surface.

Perforated Angles Are Useful Framing Members

Movable racks, storage shelves, work benches and the like are used extensively in the Philadelphia shop of John McCarthy to reduce multiple handling of materials, to facilitate the shifting of motors or equipment from one area to another, and to permit the easy and fast clearance or reallocation of floor space whenever normal housekeeping or rearrangement of areas is desirable. These various mobile or stationary structures are all fabricated in the shop, with perforated and slotted Dexion metal angles serving as framing members. Construction is simple, because angles are accurately marked for length, bent at right angles, and perforated along both legs to permit the placement of bolts at all possible connection points.

HACKSAW, wrench or pliers are the only tools required to construct a wide assortment of useful shop items from pre-fabricated perforated metal angles. Storage racks, movable carts and many other items can be so designed.

All that is necessary for construction is a hacksaw for cutting angles to desired lengths, boxes of hex-head bolts and nuts, a wrench for tightening same, factory-assembled castors and base plates and, of course, the basic original idea for the structure being formed. Although the necessity for subsequently disassembling these units is unlikely, it could easily and quickly be accomplished by removing the bolts, thereby permitting the collapse of the units for compact storage or transportation to an out-of-shop jobsite. For anyone with a "do-it-yourself" inclination, the design and construction of such structures is a pleasure, as well as also being a very practical and economical way to create equipment designed for specific purposes or to fit in specific space.

Insulation Cloth Stored On Vertical Shaft

One of several useful methods for conserving space in a small storage crib is to mount rolls of insulating cloth vertically, as is done in the shop of Wismer and Becker, Sacramento, Cal.

As indicated, supports for the bolt of cloth consist merely of two L-shaped angle iron sections secured to a vertical member of a wooden tier of stock shelves. Two flat steel bars have been secured between the two angles, thereby providing a straight tearing edge for the cloth, and two conduit straps secured to the angles hold a vertical shaft, around which the

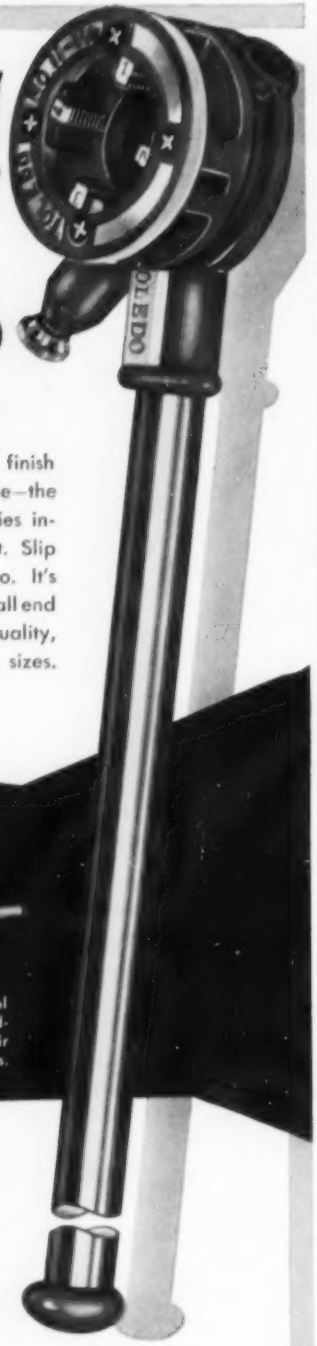
New Look!

SAME SOLID SATISFACTION

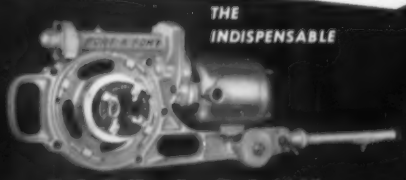
TOLEDO

SMALL RATCHET PIPE THREADERS

You'll like the rifle barrel, rust resistant finish of the TOLEDO Ratchet Threader handle—the drop head tool that lets you change dies instantly. Pull the pawl—the die drops out. Slip in another size and you're ready to go. It's that easy. Check the new bright red ball end for easier handling, better grip. It's quality, like all TOLEDO tools. ⅛" to 2" sizes. See them today at your suppliers.



THE INDISPENSABLE



PORT-A-PONY

The No. 68 Power Drive will be the handiest tool on your truck. Takes power to the job—up the ladder, on the scaffold, in the ditch. Electric or air driven. Turns, threads, cranks, lifts, pulls, or rotates. Makes an ideal bench tool, too.

TOLEDO NO. 8 FOLDING WORK BENCH

A strong, sturdy, folding vise stand that sets up easily, saves time and effort. All one unit. Has three pipe benders, tool slots, pipe rest and ceiling brace. A portable work bench that meets all needs. Weight 33 lbs.

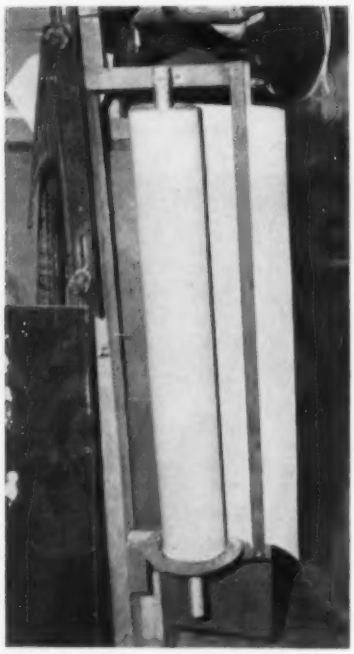
THREADED PIPE it's tight—it's best—costs less

TOLEDO PIPE THREADING MACHINE COMPANY TOLEDO 4, OHIO

BUILDERS OF THE WORLD'S FINEST PIPE TOOLS

TOLEDO®

PIPE THREADERS • PIPE WRENCHES • PIPE MACHINES

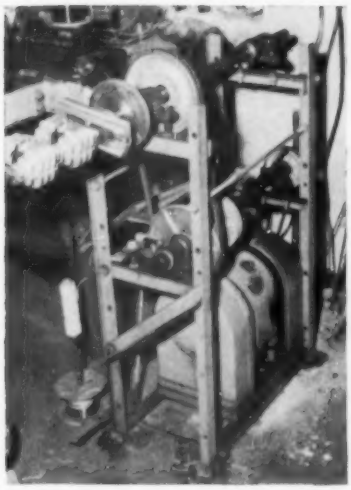


SPACE SAVING method for storing insulation cloth involves use of vertical spindle and cutting edge, with L-shaped angle iron supports bolted to framing member of storage bin.

roll of cloth can revolve freely. A galvanized steel disc at the bottom of this shaft prevents the cloth from dropping or sagging. As noted, the free end of the cloth passes between the two flat bars, thereby making it possible to tear the cloth neatly at any width and always with a straight angle.

As each roll of insulation is expended, the vertical shaft may be raised through the conduit strap as a fresh roll is inserted, then dropped back into place against the steel disc.

George C. Glenning, Spaulding Electric Co., Detroit, Mich., and Cecil R. Medsker, Miller-Seldon Electric Co., Detroit, Mich. at recent 23rd annual NISA convention in Philadelphia.



Winding Rig From Spare Parts

A shop-made coil winding rig is a busy piece of equipment in the shop of Rucker Electric Motor Repair, Paramus, N. J. It was built in three days from spare parts and a few purchased odds-and-ends. As it turned out, however, it has all the required characteristics of first-rate manufactured machines. Design and construction of this rig was done by Carl Rucker, owner of the shop.

The frame of the machine is made of lengths of T-iron and angle-iron welded and bolted as shown in the accompanying photo. The frame is braced with diagonal struts and has flange sections at the base of its legs. Power is supplied by a single-phase, ¾-hp, 120-volt motor which is part of the drive and gearhead assembly taken from an old meat chopper. Control is provided by a motor-starting toggle switch with overload relay. Power from the motor shaft is transferred by pulleys and belt to a drive shaft at the middle level of the unit. This drive shaft has a clutch plate on its end opposite to the end at which it is driven. This clutch plate is actually a face plate from a lathe with brake-lining material on its face. By use of a foot-operated lever, this clutch plate can be brought into contact with another clutch plate of the same construction, driving a short shaft which is belted to the winding shaft as shown in the photo. The foot treadle which operates the spring-restrained clutch can be seen at the lower left on the unit. A counter from an old steam engine was redesigned and coupled to the winding shaft to count coil turns.

DOSSON "F" SPLIT BOLT CONNECTOR

Fabricated from high strength alloys (better than average steels), the Dosson "F" is cold-formed for uniform quality. Maximum contact pressure is assured by a high translation of tightening torque. Full length pressure bars with rounded edges prevent load concentration and crushing of conductor. Built to withstand high overload, vibration. Highly corrosion resistant.

Mail coupon for FREE Dosson "F" Connector

LISTED UNDER REEXAMINATION SERVICE UL OF UNDERWRITERS' LABORATORIES, INC.

DOSSERT MFG. CORP.
249 Huron St., Brooklyn 22, N. Y.

Gentlemen:
Please rush free sample Dosson "F" Split Bolt Connector plus catalog sheet.

Name ..... Title .....
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Address ..... Zone ..... State .....
City .....

50 YEARS OF TECHNICAL KNOW-HOW

Excl. Canadian Distributor: W. S. Gerrie & Assoc., Ltd.
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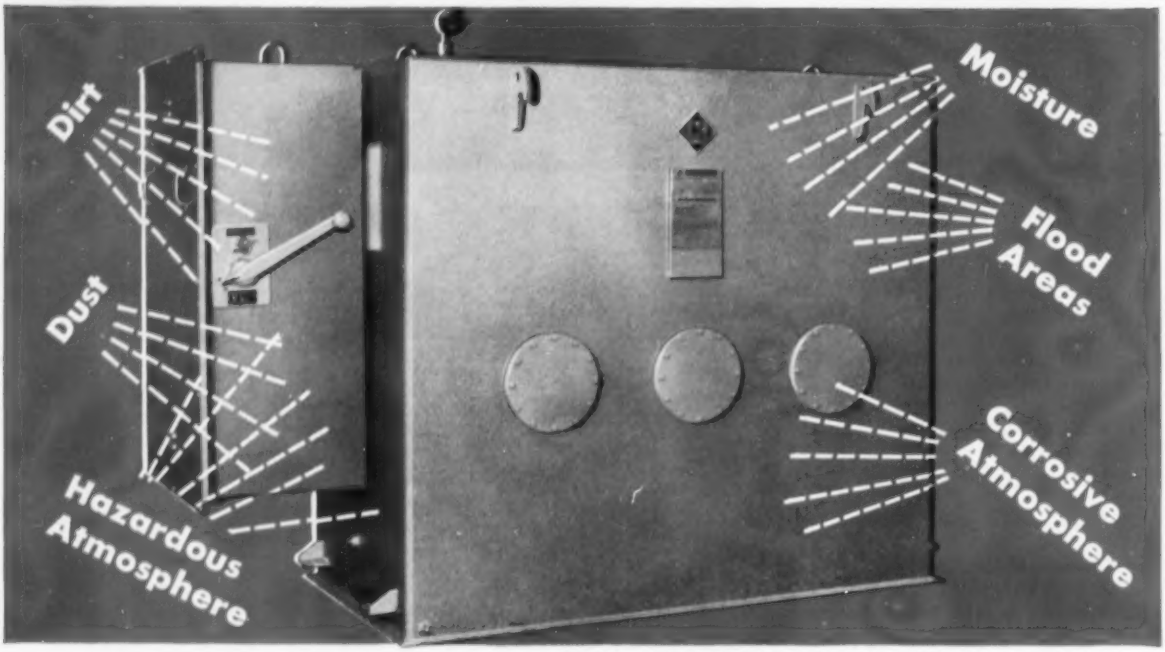
ALLIS-CHALMERS
Sealed
Dry-Type
Transformers

Designed for the *Toughest Spot* In Your Plant



SAFE in any location regardless of Atmosphere or Moisture Conditions

Here's a transformer you can safely install anyplace without worries.

- **Fire or Explosion Hazard Eliminated —** Unit is hermetically sealed in inert-dry-nitrogen atmosphere.
- **Completely Protected—**Can be placed safely in flood areas, dirty and contaminated atmospheres, or in open work areas without vaults or barriers.
- **Insulation Life Increased —** Core and coil assembly is sealed in inert gas. Eliminating oxidation reduces thermal aging of insulation.
- **Maintenance Requirements Cut —** Elimination of cooling tubes and use of smooth tank surface reduce paint area as much as 60%. No internal liquids to maintain. All-welded construction. Number of gasketed openings reduced. Cleaning of core and coil eliminated. For these reasons, unit can be installed in hard-to-get-to places.
- **Low Installation Cost —** Unit is ready to be energized immediately upon delivery, after check to make certain no damage or leaks have occurred during shipment.

Allis-Chalmers transformers have an outstanding record of satisfying thousands of users all over the country. You can get the complete story on Allis-Chalmers sealed dry-type transformers from your local A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-5035

Product News

pin is exposed at the top. A light, sharp hammer-blow against the pin fires the tool. The 22-caliber power load sends the nail-like stud into the work surface to complete the fastening. It features built-in safety. It must be held vertical to the work surface before it will fire. It must be twisted and depressed against the work before it will operate. It has a standard box-type guard at the barrel's end, and a neoprene grip that affords maximum hand traction for pushing against its operating spring.

Remington Arms Company, Inc., Bridgeport, Conn.

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in flood areas, dirty and contaminated atmospheres, or in open work areas without vaults or barriers.

● **Insulation Life Increased** — Core and coil assembly is sealed in inert gas. Eliminating oxidation reduces thermal aging of insulation.

● **Maintenance Requirements Cut** — Elimination of cooling tubes and use of smooth tank surface reduce paint area as much as 60%. No internal

to make certain no damage or leaks have occurred during shipment.

Allis-Chalmers transformers have an outstanding record of satisfying thousands of users all over the country. You can get the complete story on Allis-Chalmers sealed dry-type transformers from your local A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-5035

Product News

Motor Control Centers (1)

A new line of motor control centers, designed particularly for use where a large number of motors with ratings up to 5 hp must be protected and controlled and floor space is at a premium. They permit 10-high mounting arrangement in a standard 90-in. high section. This means that up to 20 NEMA Size No. 1 starters can be plugged into a standard 90-in. high back-to-back section. Units are supplied with NEMA Class A, B or C wiring; Class A with line connections from bus to breaker, from breaker to line starter only; Class B includes the Class A features plus individual terminal blocks in each starter; type C wiring incorporates the completely wired unit to master terminal block at top or bottom of vertical sections and "hot" conditions. Starter plug-in contacts are spring-backed for good contact with both surfaces of silver plated busses. High-impact, low-tracking insulators will support all buses. Compact 7-in. units may be mounted with 14-in. and larger modules for flexible section arrangements for motor controls ranging from fractional to 100 hp.

Federal Pacific Electric Co., Eastern Switchgear Division, 888 N. Keyser Ave., Scranton, Pa.

Tool (2)

A new low-cost powder-actuated stud driver, designed specifically for small home builders and installation contractors. It is known as "Mighty-Mite" Model 456 stud driver to fasten wood to metal or wood and metal to concrete. It is constructed of three parts and weighs 3¾ lbs. After a stud with "Power-Guide" disc attached has been placed in the barrel, the operator inserts a 22-caliber power load. When he twists and depresses the tool against the work surface, the firing pin is exposed at the top. A light, sharp hammer-blow against the pin fires the tool. The 22-caliber power load sends the nail-like stud into the work surface to complete the fastening. It features built-in safety. It must be held vertical to the work surface before it will fire. It must be twisted and depressed against the work before it will operate. It has a standard box-type guard at the barrel's end, and a neoprene grip that affords maximum hand traction for pushing against its operating spring.

Remington Arms Company, Inc., Bridgeport, Conn.

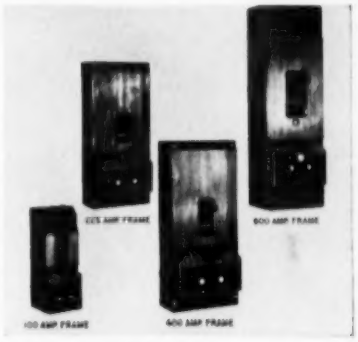
Relay (3)

A new 4-pole machine tool relay which measures 2⅛ in. wide by 3⅛ in. high, identified as Class 8501 Type DO-42, is a companion device to the 2-pole Type DO-22. Both are 10-amp 600 volts. For mounting convenience and substitution when more poles are required, both relays have identical baseplates and can be mounted interchangeably. Plastic impregnated molded coil is unbreakable, operates cooler, is dimensionally stable and impenetrable by water and oil. All contacts are visible for inspection and maintenance.

Square D Company, 4041 N. Richards St., Milwaukee 12, Wis.

Circuit Breakers (4)

A complete line of Cordon circuit breakers — the molded case type breaker with 100,000-amp interrupting rating—is now being manufactured in 100, 400- and 600-amp models. The Cordon weds a current-limiting device to a standard, molded-case circuit breaker—both in a common molded housing—to provide a compact electrical protector with high interrupting capacity. New breakers are designed for normal branch and feeder circuit applications in switchboards, panelboards, load centers, and individual enclosures. The current-limiting fuses, called Amp-traps, are coordinated to assume the fault clearing duty, when short circuits approach a predetermined value, extending the interrupting capacity to 100,000 rms amps. At lesser overloads the conventional thermal and instantaneous magnetic trips of the circuit breaker take over. Each Amp-trap contains a spring-loaded plunger that is released when the device fuses. The plunger in turn actuates the breaker trip mechanism. Cordon circuit breakers in 100-, 225, 400- and 600-amp frame sizes are available with 2- or 3-pole construction for either 250- volt dc or 600-volt ac service.



I-T-E Circuit Breaker Co., Small Circuit Breaker Div., 19th and Hamilton Sts., Philadelphia 30, Pa.

Electric Heater (5)

New Radiantglass Model 2000, is a wall-mount electric heater operating on 240 volts. Frame is of anodized aluminum, the outer section being gold and the inner section silver. It will not rust or tarnish. Heater is equipped with permanent vertical guard bars, with horizontal guard bars optional. Operates on 1000 watts, 240 volts. Btu output-3412. Overall dimensions are 51¾ in. wide and 12¾ in. high. Easily mounted on wall. UL approved. Literature is available.

Allied Precision Industries, Inc., Geneva, Ill.

NEW midwest 2-SCREW SERVICE ENTRANCE ELBOW

Product Detail:

Fitting embodies a certified malleable iron body, with a water proof gasket and 2-screw steel cap.

Threads are cleanly tapped and molded smoothly to eliminate rough edges.

Thoroughly cadmium plated for protection against corrosion.

Sizes:

Fitting hubs are threaded to fit these sizes of rigid conduit: ½", ¾", 1", 1¼", 1½", 2".

• Here is another Midwest development in providing quality fittings. "Quality" is just a condensed way of saying: "Getting the total job done—right—with the most inexpensive combination of material and man hours." Engineering and producing quality fittings to meet the highest standards of electrical wiring installations, is our objective at Midwest.

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

1639 W. WALNUT STREET
Chicago 12, Illinois

Overcurrent Tripper (6)

New overcurrent tripping devices which can be quickly and accurately adjusted in the field have been installed on some types of air circuit breakers. The new tripping devices, designated EC-2, are supplied for AK-1-15, AK-1-25 and AK-1-50 breakers, which are used in cascaded and fully-rated systems. Breakers used in selective systems will continue to require EC-1 devices. Field adjustments can be made on the time delay pickup over a range of 80% to 160% of rating. Adjustments on the instantaneous pickup cover a range of 4 to 9 or 9 to 15 times the coil rating. It is now possible to adjust the amount of time delay within the limits of each tripping characteristic curve.

General Electric Co., Schenectady 5, N. Y.

Manhole Condulets (7)

Type GUB above ground manhole condulet provides a simple means for splicing main electrical feeder cables and making branch taps. Allows maintenance personnel to inspect connections at any time. They can be installed singly or in groups to accommodate the same number of feeders and branches. There are two styles: type GUB, a deep-domed condulet with flametight, threaded fittings which is explosion-proof, dust-tight, and weather-resistant for use at hazardous areas; and type WJH, a raintight condulet for installation at ordinary locations, consisting of a flat plate with deep overhanging dome cover. Both styles are available either with or without terminal blocks. When block-equipped, voltages up to 600 can be handled. Without blocks, regular or shielded cable can be spliced for voltages up to 5,000. Equipped with breathers and drains in order to reduce internal condensation, Type GUB measures 12 in. wide, and depending upon voltage requirements, 19½ in. or 34⅛ in. in height. Type WJH condulet measures 11¾ in. wide and either 11¾ or 25½ in. in height. Shallow covers are used for voltages under 600, deeper covers for voltages up to 5,000.

Crouse-Hinds Company, Wolf & Seventh North Sts., Syracuse 1, N. Y.

Lighting Fixture (8)

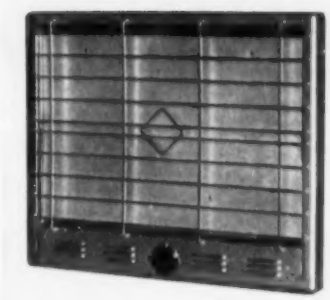
New Royal-T service station lighting fixture designed to permit maximum passage of light generated by the new RS lamps. The acrylic resin plastic enclosures incorporate a "sine-wave" or fluted form to deliver optimum diffusion. The extra surface and the additional angles in this form assure wider dispersion of light. Supplementing the new enclosure design of the Royal-T, a new pole adapter allows infinite adjustment between pole centers. The adapter slides in the base of a rigid extruded aluminum channel constructed with Heliarc welded cross braces. Bulletin is available.

Guardian Lighting Company, 500 North Blvd., Oak Park, Ill.

Wall Plates (9)

A new line of stainless steel wall plates for low-voltage, remote-control switches. They have a new contour that blends with modern interiors. The satin-like finish of plates is easily cleaned with a damp cloth. They are especially practical for commercial applications and will withstand hard usage in office buildings, stores, restaurants, hospitals and other institutions. Also for residential use in the kitchen, bath, recreation room and other locations where a bright, untarnishing metal finish is desirable. They will fit all G-E remote-control switches.

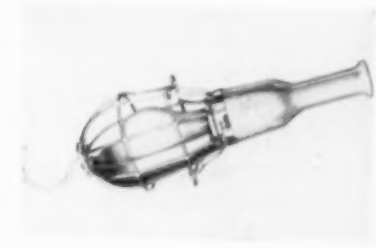
General Electric Company, Wiring Device Dept., Providence 7, R. I.



Wall Heater (10)

Wall heater with anodized aluminum heating surface incorporates a thermostat and pilot light which glows whenever unit is on. The line includes recessed and surface mounted models, rated at 1250 and 750 watts for operation on 115, 208, 230 or 245 volts, ac. Thermostat is a double pole, single throw temperature controller, automatically cutting off current when room temperature reaches thermostat setting. Heater has been approved by UL. Engineering includes the utilization of both the conductive and emissive powers of anodized aluminum. For proper heat distribution, heating element is sealed inside a specially constructed metal panel. Panel is unbreakable and shatter-proof.

Marviray, Inc., 54 Clifton St., Newark 5, N. J.



Lamp Guard (11)

A complete line of watertight, keyless lamp guards with closed-end cages and neoprene-butyl handles is now available. The handle, identified by its gray color, will not soften, swell or crack, is grease and oil resistant, and provides complete insulation against shock. Lamp guards are equipped with No-Rol cage, made of extra-heavy steel wires electrically welded and heavily zinc-plated with a chromate finish and featuring four equally spaced ears on the bottom cross wires to prevent rolling. Guards are available in several models including 7600-M with standard cage for bulbs to 50-watt size, and Model 7600 with standard cage for bulbs from 60 to 100 watts. Also available are guards equipped with Levolier switch and with or without reflector.

McGill Manufacturing Co., Inc., Valparaiso, Ind.

ON ANY WIRING JOB . . . THE COST OF CONNECTORS IS "PEANUTS"!

Why Take Chances Here?

BE SURE with

IDEAL Wire-Nuts®

THE SOLDERLESS, TAPELESS WIRE CONNECTORS

(Patented, No. 1,933,555)

The cost of wire connectors is only a tiny part of the total cost of the job. Yet the whole system is literally held together by the connectors. They are as critical to it as the mainspring is to a watch. The best is *always* the cheapest.

IDEAL "Wire-Nut" Connectors have been setting quality and dependability records for over 30 years. Many of the original "Wire-Nut" Connectors are still in service . . . as good as the day they were installed!

FULLY APPROVED!

(UL) Contractor sizes 74B and 76B are fully approved as pressure cable connectors for general use in all types of branch circuit wiring, with all common wire combinations.

Sold through America's Leading Distributors

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IDEAL INDUSTRIES, INC.
1041 Park Avenue, Sycamore, Illinois

Please send FREE SAMPLES of IDEAL "WIRE-NUTS"

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Company_____

Address_____

City_____ Zone____ State_____

Fitting (12)

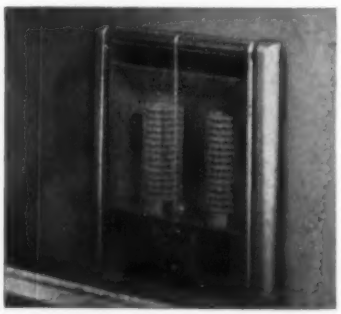
A new fitting for Cope's supporting system of prefabricated expanded metal trough. Conduit bushing drop-out allows cable to pass from cable trough into a conduit. The aluminum drop-out provides a smooth surface that protects the cable insulation. The drop-out can be placed anywhere in the trough system by cutting a hole in the trough and is attached to the trough by bolts. A clamp operated by a hollow head bolt assures that the slotted collar will grip the threaded conduit securely and provide a continuous metallic connection.

T. J. Cope, Inc., Collegeville, Pa.

Color Keying System (13)

A new method for faster and surer installation of electrical compression connectors is color keying them to their installing dies. T&B's most recent line of connectors for copper conductors employs the new color system. Each connector size in the line is marked with its color, and matching colors are used in a die of the installing tool. An installer selects the correct connector and die for a certain job by matching color.

Thomas & Betts Co., 36 Butler St., Elizabeth 1, N. J.



Electric Heaters (14)

A new line of radiant circulating electric heaters with a new type heating element, named the "Tri Core". Heat is radiated directly into the room from the two forward sides of the Tri-Core; and the polished reflector is so designed as to circulate

the heat radiated from the third side. Nickel chromium heating coil is supported in grooves of the ceramic core, which has high resistance to heat shock. Grille shields the heating element and provides protection. Having an 82% open area, it permits free flow of heated air and is easily removable for access for cleaning. A further safety feature is the enclosed connection box with terminal block which shields all electrical connections. Units are made in both automatic and manual models. In the automatic models, the sensitive thermostat bulb is placed at the bottom of the heater where cool air enters and is influenced only by changes in room temperature. It is made in capacities for large and small rooms, with one, two or three "Tri-Core" heating elements. The frame, which is finished in silver grey hammertone baked enamel, is adjustable to fit any type surface. Literature is available.

Electromode Division of Commercial Controls Corp., Rochester 3, N. Y.

Flodlight (15)

A new aluminum enclosed floodlight, Series 1700, for 750 and 1000-watt lamps. Series includes versatile mountings for crossarm, poletop, pipe and wall installations, plus new fitting for parapet mounting. Each unit is equipped with thermal shock and impact resistant lens and aluminum lens ring. Built-on wrench and watertight connector are also standard equipment. Beam spread is 96° and beam lumens 11350 using PS-52, 1000-watt lamps. Literature is available.

Steber Manufacturing Co., Broadview, Ill.

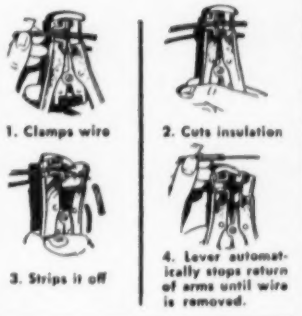
Box-Bar Hanger (16)

A new line of box and bar hanger combinations in a variety of types. Built to standard dimensions of 4 in. by 1½ in. deep, the octagon boxes come mounted on either shallow or deep offset bar hangers 19½ in. or 24 in. long. The boxes are furnished with "BX" clamps for armored cable and flexible metallic conduit installation; Romex clamps for installing non-metallic sheathed cable or flexible tubing; ½-in. knockouts for rigid metallic conduit. Made of heavy gauge steel, the boxes are available in corrosion-resistant

NOW! STRIP UF CABLE with IDEAL "E-Z" AUTOMATIC WIRE STRIPPERS

. . . as easy to use as your pliers!

With the "E-Z" it's easy to strip the outer sheath and web, then the inner conductors (2 or 3 wire 12 or 14 ga.) from non-metallic sheathed cable — without cutting, nicking or other damage to the wire ends. The "E-Z" Automatic is lightweight yet durable all-steel construction for long, heavy duty service life. Available in 5 other models for stripping various types of wire from 8 through 26 ga.



1. Clamps wire
2. Cuts insulation
3. Strips it off
4. Lever automatically stops return of arms until wire is removed.

. . . and for ordinary non-metallic cable

IDEAL DELUXE CABLE RIPPERS

A practically designed mechanic's tool for quickly and easily ripping the outer sheath from non-metallic covered cable up to ½" O.D. Faster—just insert the cable, set blade depth and rip away. Rigid frame and cradle assure straight cut. Replaceable steel blade; durable aluminum rip-grip for speed and safety.

Sold through America's Leading Distributors. In Canada: Irving Smith, Ltd., Montreal.

IDEAL INDUSTRIES, INC.
Park Avenue, Sycamore, Illinois

Please send us your catalog on the complete line of Ideal Electricians Tools.

NAME_____

COMPANY_____

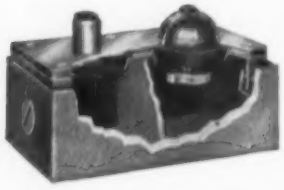
ADDRESS_____

CITY_____ ZONE____ STATE_____

IDEAL

Latrobe
Electrical
Products

Clean and compactly designed to cut installation time to the bone and give smooth, trouble-free service "Latrobe" Products give a full measure of value.



Two Gang Adjustable Floor Box

Adjustable Boxes come in single-round or square bodies. Also in square type Single Gang, Two Gang, Three Gang and Four Gang Boxes. All adjustable boxes are now bonded which makes them fire-proof.

Non-Adjustable Floor Box

Represents the last word in unique design, neat appearance, fewest number of parts, and least amount of labor to install.

Insulator Supports

Malleable iron clamps of high tensile strength. Four sizes to fit all standard porcelain or glass insulators.

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Non-Adjustable Floor Boxes
Adjustable Floor Boxes
Gang Boxes . . . Cover Plates
Junction Boxes . . . Nozzles
Pipe or Conduit Hangers
Insulator Supports
Cable Supports . . . Fish Wire
Staple and Cable Clips

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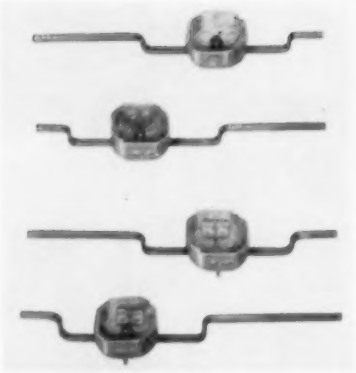
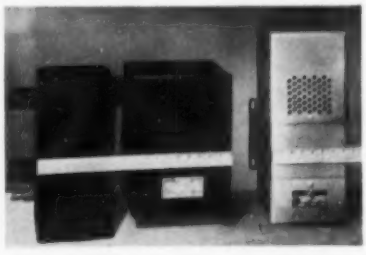
Sales Representatives in all principal cities.

Fullman Manufacturing Co.
1209-1215 JEFFERSON STREET
LATROBE, PA.



galvanized or baked aluminum enamel finish. Bar hangers are made of ⅞-in. by ⅛-in. band steel with rounded mill edges. Boxes are attached to bars with adjustable malleable iron studs and loops, or without studs and loops in new permanent type design. Literature is available.

Keystone Manufacturing Co., 23328 *Sherwood Road, Center Line (Detroit), Mich.*



Transformers (17)

Design improvements have been made in Type CVH harmonic-neutralized constant voltage transformers in three capacities. They are smaller in size and lighter in weight. Electrical characteristics are unchanged. Regulation is plus or minus 1% over a newly-expanded primary voltage range of 95 to 130 volts. It is especially suitable for input to a rectifier when close regulation of the dc output is required. Type CVH design provides labeled input and output terminals on a panel within the outlet box at one end of the assembly. It is finished in gray hammerloid. Three capacities are available—250, 500 and 1000 va.

Sola Electric Co., 4633 *W. 16th St., Chicago* 50, *Ill.*

Fire Alarm System (18)

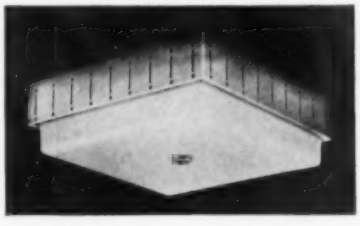
New automatic fire locator and alarm system. It is also available for operation from standby batteries in event of failure of light and power service for this system. A fire is located by means of indicator lamps on the control panel. Each lamp indicates a zone. Audible alarms throughout the building serve as a warning or evacuation signal to the occupants. The entire system is electrically supervised—should a fault occur in the wiring, the trouble bell will automatically sound until the fault is corrected. Both automatic heat detectors and manual stations are used in the system for fire detection. Available with a fixed temperature UL rating of 400 sq ft and a combination fixed temperature and rate-of-rise feature rated at 2,500 sq ft.

Edwards Company, Inc., Norwalk, Conn.

Exit Lights (19)

A new line of U.L. listed recessed and surface-type exit lights consisting of 198 varieties to meet all local codes has been introduced. Featuring one-piece body-frames of fused steel, all units are furnished with a rust-proof, dirt-resisting, neutral tone aluminum bronze. Interior reflecting surfaces are finished with baked white Fluracite enamel. Glass bottom panels in all surface-type units provide added illumination over point of exit. Another feature is the upward opening door for relamping or maintenance. Literature is available.

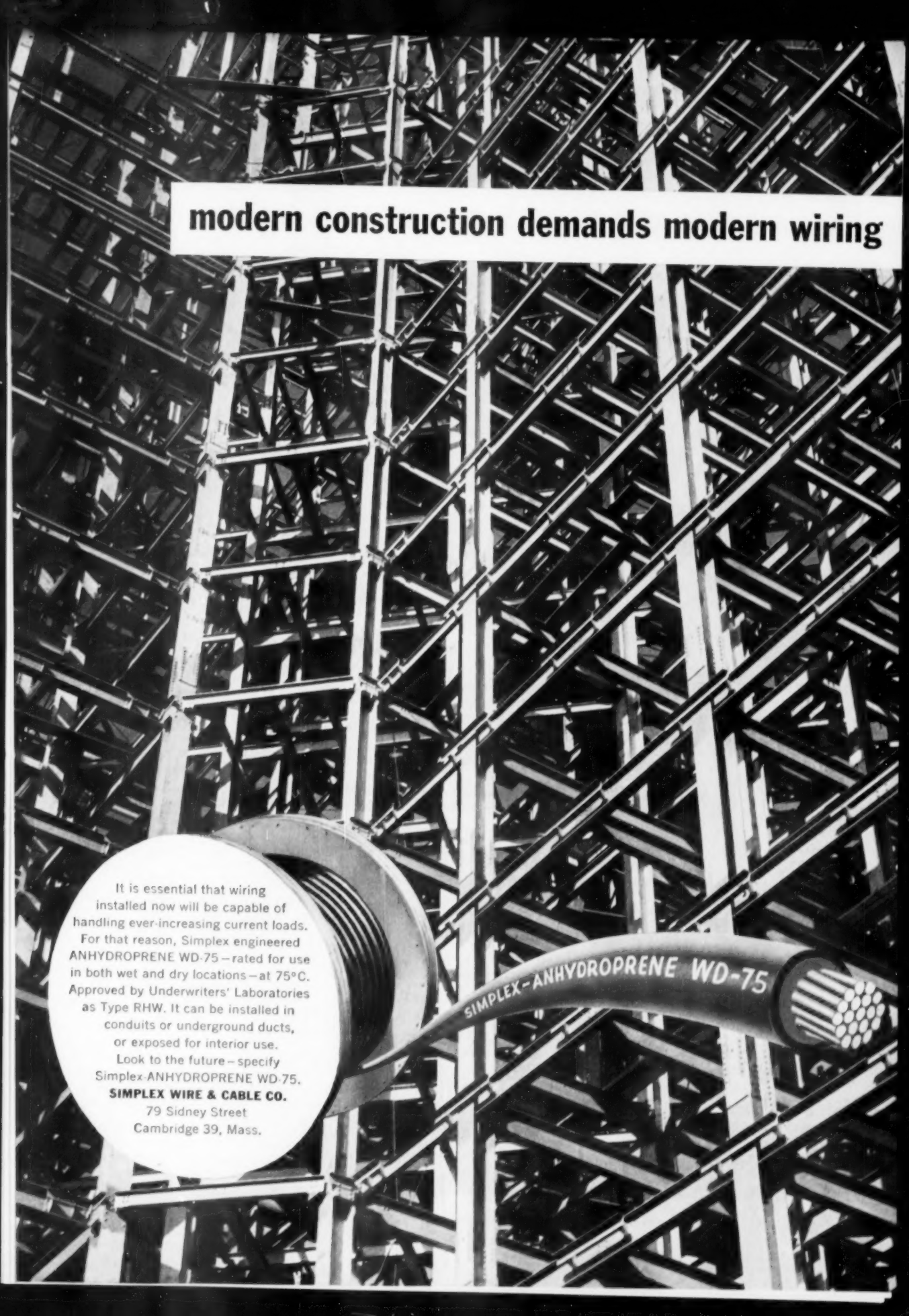
Curtis Lighting, Inc., 6135 *West 65th St., Chicago* 38, *Ill.*



Lighting Fixtures (20)

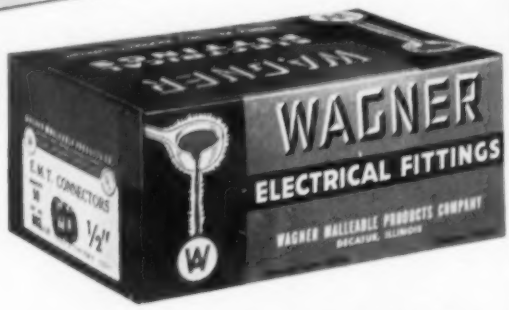
Nos. 895 and 896 2- and 4-lamp line leaders with unlimited lighting application in kitchens, corridors, playrooms, porches and similar locations. Extremely shallow, these fixtures with satin brass and chrome finishes, feature safety mounting of glass and lock-seamed and welded housing. Side piercing gives luminous ceiling effect with milk white glass providing diffusion of light.

Lekrolite, Inc., Wallingford, Conn.


modern construction demands modern wiring
It is essential that wiring installed now will be capable of handling ever-increasing current loads. For that reason, Simplex engineered ANHYDROPRENE WD-75 – rated for use in both wet and dry locations – at 75°C. Approved by Underwriters' Laboratories as Type RHW. It can be installed in conduits or underground ducts, or exposed for interior use. Look to the future – specify Simplex-ANHYDROPRENE WD-75.
SIMPLEX WIRE & CABLE CO.
79 Sidney Street
Cambridge 39, Mass.
SIMPLEX-ANHYDROPRENE WD-75

★ SET SCREW

★ COMPRESSION



★ BM INDENTER

ON EVERY JOB FOR
COMPLETE SATISFACTION

The best service in EMT fittings is provided for you because of the availability of a complete line . . . types and sizes for all installation needs.

Specify Wagner and get uniform highest quality together with tough, precision-threaded, perfectly finished, easy to work with fittings.

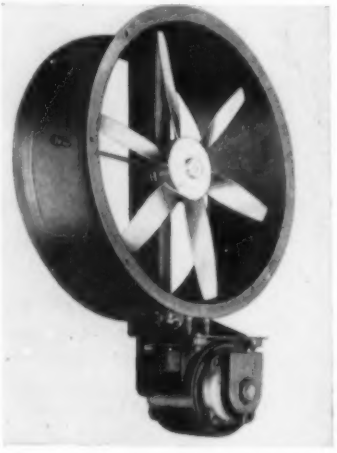
Each Wagner carton is labeled for complete and quick identification.

WAGNER MALLEABLE PRODUCTS CO.
General Sales Office: 222 W. Adams St., Chicago 6, Ill.
Foundry and Plant: Decatur 60, Ill.

Pipe Bender **(21)**

Light weight RC remote control benders. Known as "One Shot" bender making any degree bend in one setting, and available for pipe or rigid conduit, bus bar and for radiant heat. It can also be had to bend EMT or copper tubing, and with a pipe straightener, if used with the standard all purpose frame. Bender is available with bending shoes for 1-in. to 2-in. No. RC 200/C or for ½-in. to 2-in. No. RC 200/PH. Unit can also be obtained with an electric motor pump, can be used anywhere on the job and in any position. Bending frame has a removable top-plate which permits laying the pipe in from the top, slide in from the side or hook the bender over installed pipe.

The Tal Co., 417 N. Water St., Milwaukee 2, Wis.

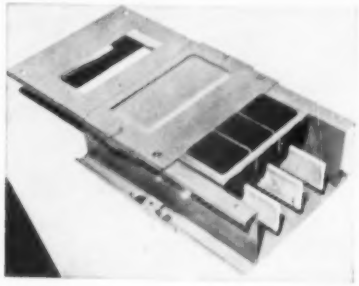


Fan **(22)**

A new duct or Tubaxial fan for paint spraying booths, industrial ventilation and exhaust. Various selections of hp for each size allows a wide range of air capacities. V-Belt drive and motors are both isolated from the air stream so that there is no contamination to the motor or belt from vapors carried in the duct work.

Both fan and motor are fitted with ball bearings so that they may be mounted in any position. Fan blades are non-sparking, heavy cast aluminum, making them suitable for handling explosive gases. Motors are open drip-proof ball-bearing motors for 1750 rpm. Totally enclosed or explosion-proof motors can be furnished if desired. Single-phase motors are capacitor-induction type. Three-phase motors are induction type.

Peerless Electric Co., Fan and Blower Div., West Market St., Warren, Ohio.



Plug-in Bus Duct **(23)**

A new design of insulator for plug-in bus duct for heavy duty commercial and industrial electrical distribution, that will withstand fault currents of 50,000 rms amps has been developed. Tests were conducted on type 50,000 WC plug-in bus duct loaded with 3-phase fault currents ranging between 46,000 and 57,000 amps. Individual arcing fault tests were conducted to prove the product under extreme conditions of heat shock. An additional 2500-volt dielectric test was conducted.

Federal Pacific Electric Co., Scranton, Pa.

Florescent Light Strip **(24)**

Covette fluorescent light strip is for coves, valances, showcases, area strip lighting and similar locations. It incorporates an end bracket construction that serves as an end plate as well as a connector for joining fixtures for continuous rows, eliminating connectors and fittings. One type of bracket supports holders for either single or bi-pin lamps, assuring uniformity in continuous installations. The end opening is concealed by an end cap. Unit is shallow and may be placed on its side or back without bolt heads or nuts protruding. Fixture comes in 18- to 96-in. lengths.

Zane Manufacturing Co., 20 East Concord St., Boston, Mass.

DRIVE-IT® 330

CARTRIDGE-POWERED STUD DRIVER

SAVES TO 80% FASTENING TO CONCRETE OR STEEL

Construction and maintenance men, nationwide, are cutting costs with DRIVE-IT powder-actuated tools. Does 15 minutes work in 15 seconds. Users report time and money savings up to 80% over drilling and other outmoded methods. Electrical, heating and ventilating, plastering, general construction—wherever anything must be fastened to concrete or steel, DRIVE-IT tools are money-makers for their users.

Exclusive DRIVE-IT Advantages

1. ONE POWER LOAD. Only one strength power load needed — whether concrete is soft or hard. No need to buy several strength loads.

2. LIGHTWEIGHT and EASY-OPERATING. The DRIVE-IT 330 weighs less than 6 pounds, is only 13 inches long. One motion opens or closes breech. Automatic cartridge ejection. Trigger-operated.

3. SAFE. Large safety pad plus built-in safety mechanisms protects operator. Tool must be depressed against work surface before trigger can be pressed. Can't be fired accidentally.

4. VERSATILE. Standard ¼-inch barrel can be replaced easily with ⅜-inch barrel for driving larger studs. Uses same low-cost power loads. Over 50 types and sizes of drivepins available.

***DRIVE-IT* Dealers Are Fastening Experts Who Give on the Job Service**

SEE YOUR DEALER OR MAIL COUPON FOR A DEMONSTRATION

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Portland 6, Oregon

☐ Send literature on DRIVE-IT tools.
☐ I want a free DRIVE-IT demonstration.

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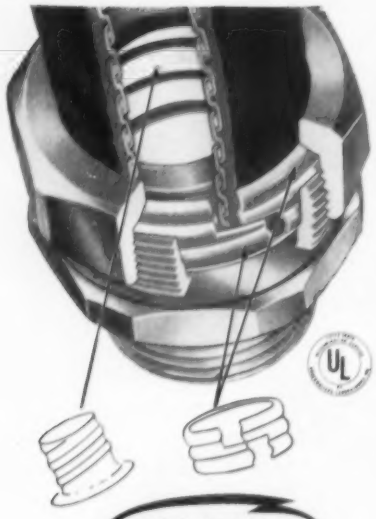


IDEAL

SIMPLET

VAP-OIL-TITE CONNECTORS

For Liquid-Tight Flexible Metal Conduit

The only completely REUSABLE connector!

PROVIDES PERMANENT WIRING PROTECTION

● Easy-to-apply... Ideal-Simplet Vap-Oil-Tite Connectors adjust quickly to conduit size variations. They positively seal out vapor, oil, water or dust. Grounding bushing assures positive ground . . . flange covers raw ends of conduit . . . and you can actually see that the bushing seats all the way!

Exposed parts all *non-corrosive* metal, Vap-Oil-Tite Connectors have positive ground, tapered threads, and tremendous gripping power through serrations on split ring. Underwriters' Laboratories, Inc. approved with 200 lb. pull test. Fit both EF and UA conduit. Write for further details and prices.

IDEAL

IDEAL-SIMPLET FITTINGS, INC.

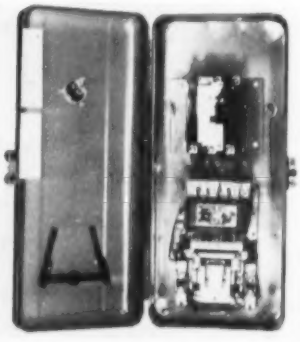
A Subsidiary of Ideal Industries, Inc.

1041 Park Avenue • Sycamore, Illinois

Load Centers **(25)**

A complete line of load centers, from two to 42 circuits, featuring the QO panelboard breaker. The QO's Swingrip mounting feature assures proper positioning of the breaker and a firm, positive connection in one operation. Its non-interchangeability feature discourages the substitution of 30, 40 or 50 amp breakers where 15- or 20-amp devices originally have been installed. In addition, the QO incorporates quick-make and quick-break, ambient-compensated and thermal-magnetic features. Flush, surface and raintight devices are available, lugs only, split bus or main breaker types. Two to eight circuit devices are available without doors, while 12, 20, 30 and 42 circuit devices are furnished with doors. Doors are automatically furnished with a spring catch which can be replaced by a flush panel-type lock. The line is UL approved and meets Federal Specification WP-131A, Class A.

Square D Company, 6060 Rivard St., Detroit 11, Mich.



Circuit Breaker **(26)**

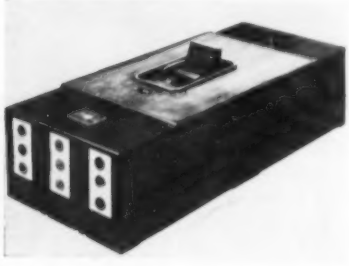
A new "E" frame circuit breaker has been developed, which is now standard on all G-E combination starters with breakers rated 250 volts, 100 amps maximum. The new design and also the 600-volt form now include provision for using the same type of handle mechanism currently used on combination starters with a disconnect switch. This mechanism mounts directly on the breaker. Meeting JIC specifications, this circuit breaker form of combination starter is engineered so that the starter handle can be padlocked only in the off position. "E" frame breaker has an interrupting capacity of 7500 amps and will be supplied on G-E CR 7008 combination starters, CR 7010 combination reversing starters, and CR 7108 combination multi-speed starters in sizes 0-3.

General Electric Co., Schenectady 5, N. Y.

Instrument **(27)**

A new Model No. 58 Brunt fault-finder for locating accidental ground faults on energized power circuits. It is a combination ground detector and fault locator for use on normally ungrounded power circuits while these circuits are energized. It was especially designed for use in plants having several distribution centers of widely separated voltages and can be used on voltages from 120 volts to 600 volts. The new model is housed in a No. 16 gauge steel and aluminum cabinet with grey hammertone finish, 15-in. high, 8 in. wide, 7 in. deep.

Parr Manufacturing Corp., 48 Hale St., Cranford, N. J.



Circuit Breaker **(28)**

An 800-amp M-frame circuit breaker, approved by Underwriters' Laboratories for operation at this continuous current rating. Breaker can be used in panelboards, power-panels, switchboards, motor controls, bust duct plugs and individual enclosures. It offers optional pressure connectors for either double or triple cable connections per phase within

YOU DON'T NEED THIS . . .

with the new Westinghouse raintight safety switch!

Enclosures for the new Westinghouse Type G safety switch—in 30-, 60-, 100- and 200-amp ratings—meet all code requirements for outdoor installations with outdoor service entrance equipment, on oil-well and water-well rigs, and many others.

Galvannealed steel makes up the raintight construction of the enclosure box and cover. A Bonderized base coat, plus an added baked-on gray enamel finish, helps keep all kinds of weather on the outside. Added weather protection is afforded by a swing-up cover which latches in the opened position for easy wiring and maintenance.

The switching capacity of the new Westinghouse Type G switch far exceeds Underwriters' Laboratories requirements. What's more, such Type G features as straight-through wiring, one-piece copper break contact, and Rosite base assembly now come in a more compact design that can save you up to 35% more valuable mounting space.

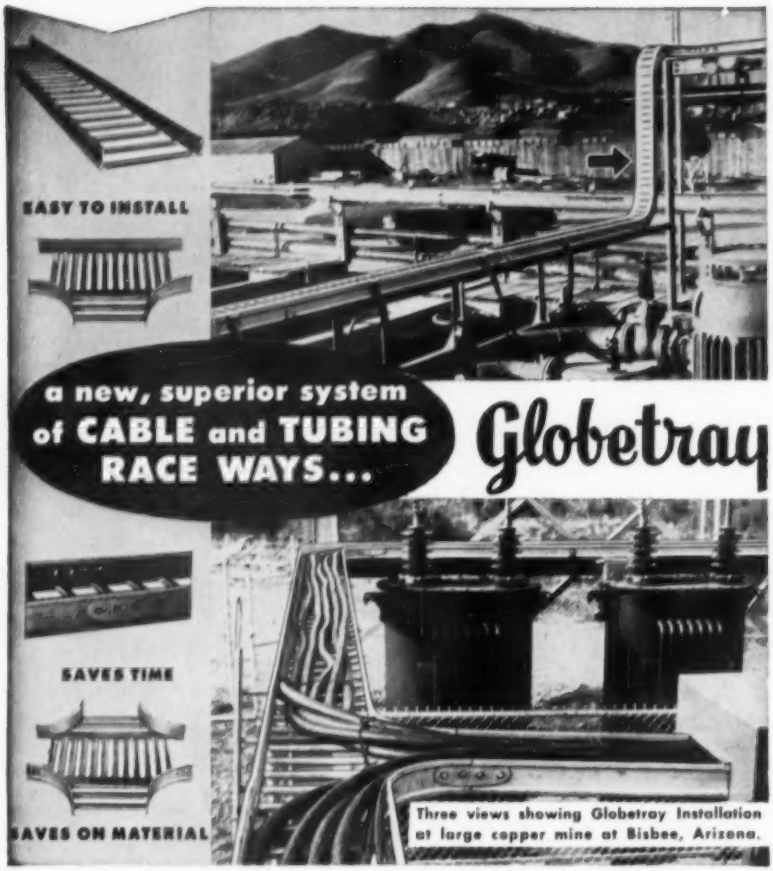
See your Westinghouse distributor. He can fill your raintight safety switch requirements right off the shelf. Or, write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. Just ask for safety switch bulletins SA-7771 and DB-30-150. J-30217

INTERCHANGEABLE HUBS—Five different conduit sizes can be used with any Westinghouse raintight Type G safety switch. Interchangeable hubs in ¾-, 1-, 1½-, and 2-inch sizes are avaliable right from your distributor's shelves. Pressed-in hubs, 2½ and 3 inch, are available on special order.

SWING-AWAY BRACKETS—Two mounting straps on the back of the raintight enclosure can be bent into position for mounting the switch on uneven surfaces—permit either surface or pole mounting.

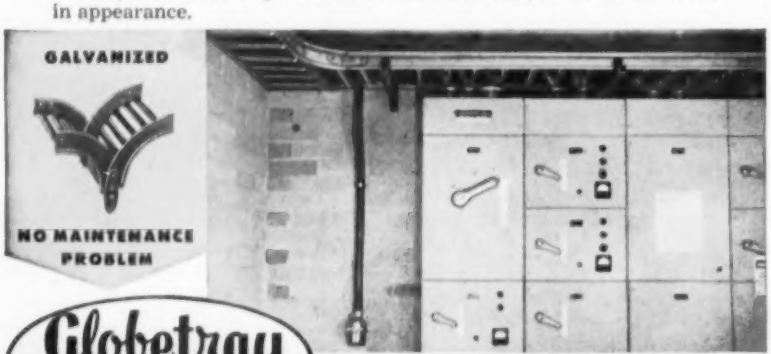
WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***



A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point – insides and bottom always smooth – all sections punched for easy installation – perfect fit at all times. Neat, clean and uniform in appearance.



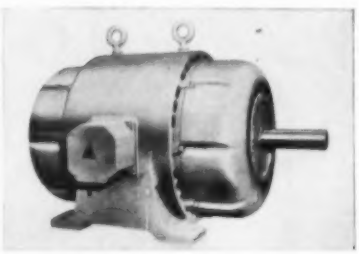
Write for new complete catalog. Distributors in all principal cities. Contact the Grip-Strut distributor under "Conduits" in the classified telephone directory.

Manufacturers Since 1914 **The GLOBE Company**

4032 S. PRINCETON AVE. • CHICAGO 9, ILL.

the circuit breaker case. Double 300 to 500 mcm cable connectors are available for breakers rated 600 and 700 amps. Triple 300 to 400 mcm or special double 600 to 750 mcm connectors are available on breakers rated 800 amps. 3-in. pole-center design dimensions permit accessibility for front cable or rear bus and stud connections. Type ET 800-amp breaker is available with interchangeable trip units providing continuous 600-, 700- or 800-amp ratings in 2- or 3-pole construction for 250-volt dc and 600-volt ac service. Interrupting ratings are 25,000 amps at 600 volts ac, 35,000 amps at 480 volts ac, 50,000 amps at 240 volts ac and 20,000 amps at 250 volts dc.

I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.



Motor (29)

A new type of totally-enclosed, fan-cooled motor in the size range from 50 to 200 hp, featuring a double-end ventilation system. The design employs two external cooling fans, one at each end, which draw cool air directly across each bearing, then drive it the length of the motor through large cooling tunnels cast in the walls of the main frame. Slot cell insulation is Mylar, bonded to high quality electrical paper, the stator, after winding, is insulated with Delcote insulation. Bearings are open type with provision for regreasing and pressure relief without removing any part of motor, should servicing be desired.

Delco Products Division, General Motors Corp., Dayton 1, Ohio.

Reflector (30)

A new aluminum "Uplight Reflector" has been designed for greater uplight from the new color corrected mercury vapor lamps, H400-RC1, and H1000-C75, used in high bay lighting. The use of this new lighting system is especially recommended for high factory bays, power plants, foundries, truck and rail shipping depots, warehouses, and similar locations where distribution of necessary light is a problem. Reflector measures 24 in. in diameter. It utilizes a new open top design, which results in 18% uplight when used with the H400-RC1 lamp,

and 16% with the H1000-C15. They are furnished in either socket-reflector or separable-socket (disconnecting) mounting types.

Abolite Lighting Div., The Jones Metal Products Co., West Lafayette, Ohio.

Lighting Fixture (31)

A new group of lighting fixtures especially designed for modern low ceilings, and known as the Mohawk series. Available in four different styles of shielding, will harmonize with almost any type of architecture. Available in two widths; the "Chief", which is 13⅜ in. wide; and the "Super-Chief", which is 23¾ in. wide. In addition, the shielding can be obtained in the form of plastic louvers, metal louvers, dished plastic, or a low brightness lens. The louvers were designed for use in stores, lobbies, or hallways where appearance is important. The dished plastic and low brightness lens are intended for offices, conference rooms, and schools where glare is a problem. Fixtures which are available in both 4- and 8-ft units may be surface mounted in a continuous-row installation. They are only 3¾ in. deep which makes them adaptable for low ceilings. Both the 4- and 8-ft units are available with dual 40-watt rapid start ballasts. The 8-ft units are also available with dual 75-watt instant start ballasts.

Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

...here's a tip for **MOTOR REPAIR MEN**
from GENUINE JOE

GENUINE
Wagner BEARINGS
stand heavy pressure without scoring shafts

Genuine Wagner bearings are steel-backed, babbitt-lined, precision bored.

Laboratory tests proved them able to stand heavy pressure with a low temperature rise. After 2½ years of continuous operation under a belt pull of many times full load, *no shaft scoring developed.*

Wagner bearings are highly resistant to corrosion and have excellent anti-seizure properties.

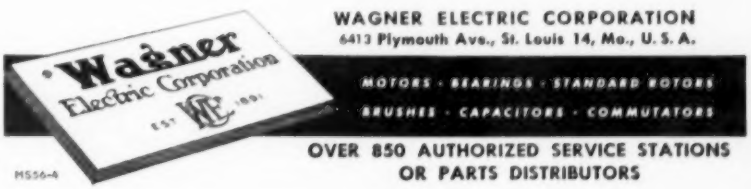
it's *easy* to replace **Wagner** bearings too...

bearing tool removes old bearing and perfectly aligns new Wagner bearing in one operation. No pounding . . . no reaming . . . no botched jobs.

It's wise to stock Wagner Replacement Motors

Smart motor repairmen always carry a stock of Wagner Replacement Motors. They come in handy for emergency use when your customer needs immediate service and they're easy to sell as replacements for motors "too far gone" for repairs.

WAGNER ELECTRIC CORPORATION
6413 Plymouth Ave., St. Louis 14, Mo., U. S. A.



MOTORS · BEARINGS · STANDARD ROTORS
BRUSHES · CAPACITORS · COMMUTATORS

OVER 850 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS

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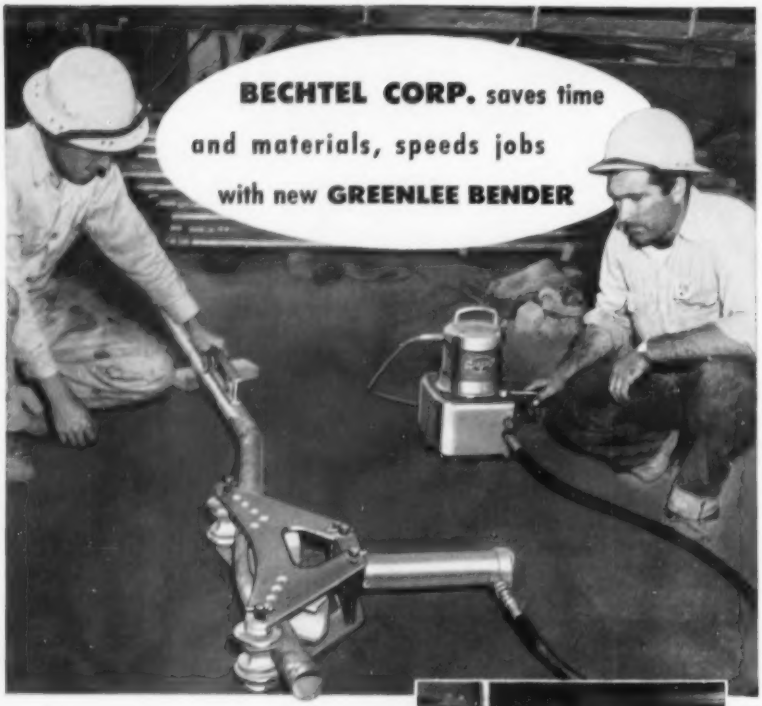
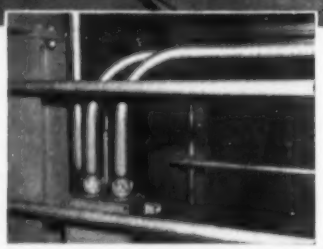


Easy portability, ability to work in tight quarters, full 90° bend with one stroke... all are features you'll like, too

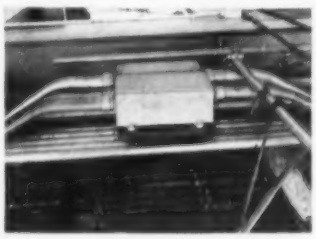
Bechtel Corporation, a world-wide organization specializing in construction of power plants, refineries, pipelines, and hydro-electric projects, makes big jobs move fast . . . and right.

On one of this firm's latest jobs . . . building a new 330,000-kw steam power plant for Southern California Edison Company . . . thousands of conduit bends were required. As shown here, Bechtel Corporation chose GREENLEE No. 880 Hydraulic Conduit Benders and No. 798 Power Pumps to help speed the work.

In commenting on its experience with the GREENLEE Bender, Bechtel Corporation reports that important advantages are its easy portability, plus ability to make bends in a trench or narrow area . . . easy forming of a 90° bend in one operation . . . elimination of material spoilage . . . big time savings.



Smooth, accurate conduit bends made on Bechtel Corporation power plant job with the GREENLEE No. 880 Bender.



Designed for fast, smooth bending of ½" - 2" conduit, this *lightweight*, portable GREENLEE No. 880 Hydraulic Conduit Bender can bring big time and material savings to your jobs, too. Operate it either by hand or with a power pump, according to your job needs. Get the complete story now . . . write for folder E-217.

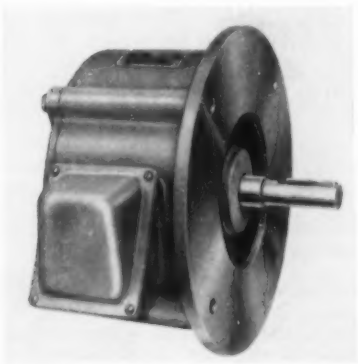
GREENLEE

GREENLEE TOOL CO., 1747 COLUMBIA AVE., ROCKFORD, ILLINOIS

Aerial Lift **(32)**

A new type of aerial lift specifically designed for all street light maintenance work. Known as Lamp King, it is a hydraulically-operated boom for carrying workers aloft and maintaining them on a constant work base at any required level. It is equipped with an insulated crow's nest, and outer boom, with dielectric strength of 20,000 volts, and rotates upon a truck-mounted turret. The turning arc of the turret is 400°-40° past full circle. Because street light work presents special problems of swingclearance and traffic interference, the unit's upper and lower booms are so proportioned as to provide a maximum of maneuverability. The lowest-level luminaire and the 36-footer thus become equally accessible.

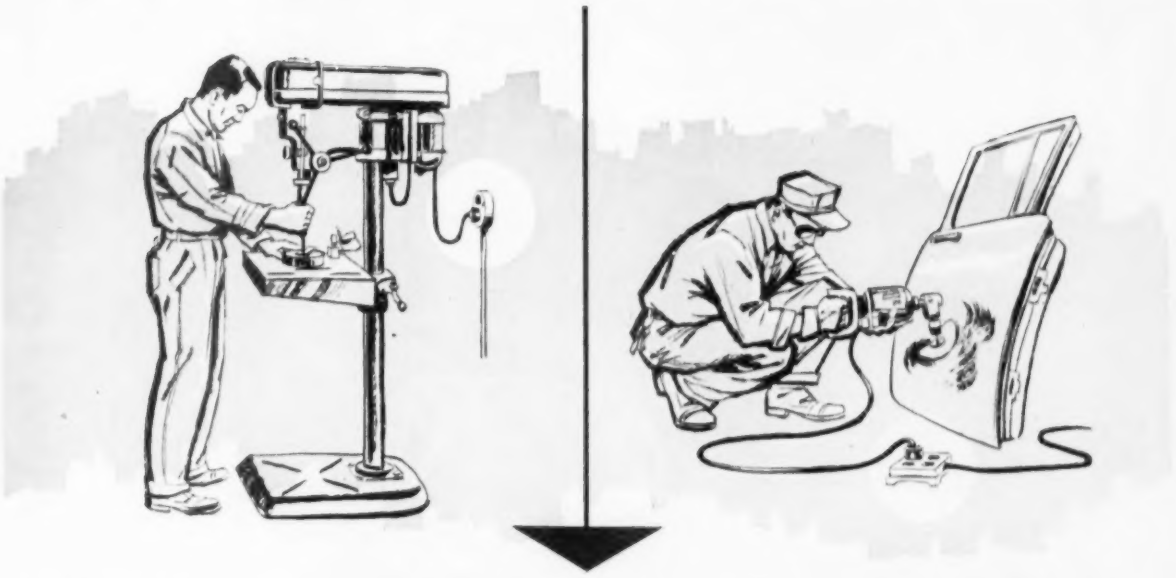
Maxwell Equipment Company, Inc., Ford St., Milford, Conn.



Motor **(33)**

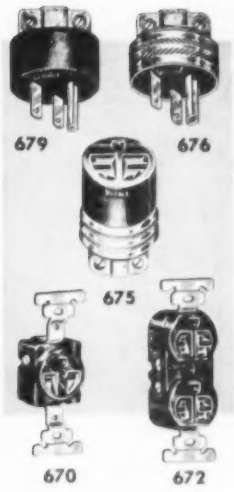
This new flat-type motor, in totally-enclosed fan-cooled or totally-enclosed non-ventilated designs, was designed to meet the specifications for NEMA design "B" motors. It was developed for use in machine tool and equipment industries for operating turret lathes, punch presses, milling machines, pumps, oil burners, exhaust system and similar applications where there is a minimum of space. The flat-type units are of standard radial design,

GROUNDED...FOR SAFETY



WITH RODALE PARALLEL AND TANDEM 3-WIRE GROUNDING DEVICES

A COMPLETE LINE OF QUALITY
3-WIRE RECEPTACLES, CAPS AND CORD CONNECTORS



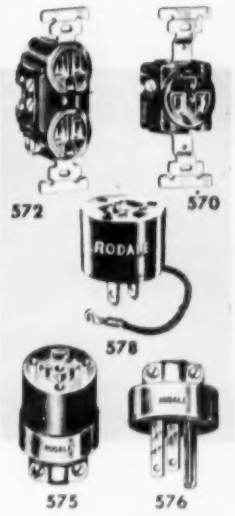
250V

Where equipment is operated at more than 150 volts to ground, where equipment is operated by persons standing on metal floors or in wet places, in hazardous locations . . . NEC makes it mandatory to ground electrical equipment. Grounding is also advised for installations where 125 volt equipment is used.

THAT MEANS: equipment must be produced with 3-wire grounding caps . . . and 3-wire grounding receptacles must be installed to accommodate this equipment in home, commercial and industrial locations.

AND THAT MEANS . . . Rodale parallel and tandem devices! Rodale offers a complete line of precision-manufactured receptacles, caps and cord connectors for every 3-wire grounding device application. Incorporating top quality materials and rugged construction . . . available in a variety of materials—bakelite, rubber, neoprene, metal . . . Rodale 3-wire devices are better because they are designed to do a *better* job!

Insist on Rodale for all your wiring device requirements . . . it's your assurance of top quality at no more than regular cost.



125V

Sold only through Electrical Wholesalers

Write for complete information to:

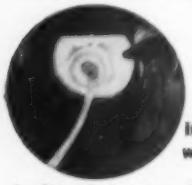
Rodale MANUFACTURING CO., INC. DEPT. E7 EMMAUS, PENNA.

Electrical Contractors:
For top performance . . . Specify RODALE!

Ask these questions, too, when you judge a fluorescent lamp . . .

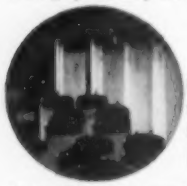
Is your investment protected?

Check Westinghouse Fluorescent Lamps against any other brands you are now using. Check them for maintained brightness, long life, uniform appearance. If you are not entirely satisfied on all counts, your full purchase price will be refunded.



Is it built with tailored glass?

Quality of glass in a fluorescent lamp directly affects lamp performance. Westinghouse makes all of its own fluorescent lamp glass, tailoring it from silica to finished tubing specifically for fluorescent service.



Is it the correct type, size and color for the lighting job to be done?

In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and merchandising application. Colors include seven different shades of "white" alone.

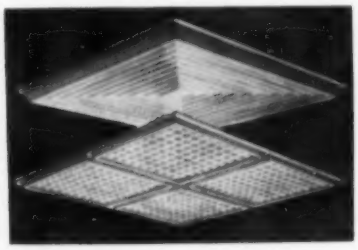
For the full story on how to get more for your money in fluorescent light, contact your Westinghouse Lamp Representative. "You can be sure if it's Westinghouse."

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

constructed like conventional squirrel cage motors. Operating at 208, 220/240 or 550 volts, 2- or 3-phase at 60 cycles, continuous or intermittent duty, the motors are available in ratings ranging from ½ to 7½ hp. Also available for special voltages.

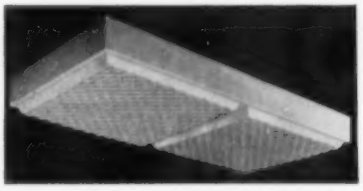
Diehl Manufacturing Co., Somerville, N. J.



Lighting Panels (34)

Sound-dissipative translucent lighting panels for luminous ceilings. Utilizing the proven concepts of perforated surfaces for a high noise reduction coefficient, the Iso-Sonic panels are ideal for use in air conditioned rooms where free circulation is required between upper ceiling chambers and room areas. For maximum light diffusion and sound dissipation the perforated Iso-Sonic panels are used with Iso-Lyte (non-perforated clear plastic) panels inverted and spaced above the Iso-Sonic panels. The 2-part Iso panels may be separated for cleaning. All panels have continuous aluminum edgings around each panel. The specially designed triangular cross-section gives maximum strength and forms retention in all planes.

Iso Industries, Inc., 1654 Lincoln Blvd., Santa Monica, Calif.



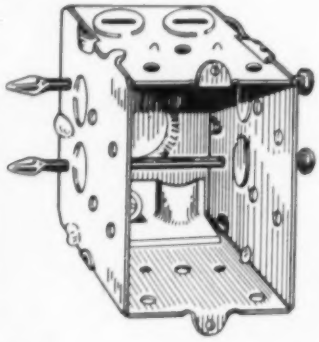
Lighting Fixtures (35)

New Custom-Liter units, featuring a high-efficiency, low-brightness light source, are adaptable to a variety of installation patterns. They are equipped with G-E ballasts and die-formed square plastic drop panels which can be removed by unfastening hinged center-supporting bracket. Knockouts are provided for end-to-end, side-to-end or side-to-side mounting. A channel provides wireway for continuous-row installations. They are available in 2- and 4-lamp, 24-in., 48-in. and 96-in. units.

Also available are two 3-ring, pendant-type incandescent concentric ring fixtures, Series 5000 and 5500. Units utilize 1600-watt, 660-volt, heavy-duty black porcelain sockets.

All units are approved by Underwriters' Laboratories. Catalog is available.

H. E. Williams Products Co., Carthage, Mo.



Boxes (36)

New galvanized 2½-in. deep flat bottom boxes, No. W384, for non-metallic sheathed cable and also same type box, No. W222, to be used for ½-in. conduit, have been added to this line. They are equipped with nail-holes, leveling bumps and plaster markings, and are sized at 3 in. in length, 2½ in. deep and 2 in. wide. Also available are "Nail-Fast" type boxes for non-metallic sheathed cable and ½ in. conduit. Catalog is available.

H. E. Williams Products Co., Carthage, Mo.

Product Briefs

(37) New grid alloys and other improvements have been made in the Exide-Tytex flat-plate **battery** line for stationary power applications by Exide Industrial Division of the Electric Storage Battery Co., Philadelphia, Pa. . . . . (38) The Standard No. 20 Beaver "Speed-Cut" abrasive **cutting machine** manufactured by Beaver Pipe Tools, Inc., Warren, Ohio, is also made in what is called the Hi-Boy, which cuts pipe up to 12 in.

(39) A new waterless **air-conditioner furnace** for year-round climate control called the Weather-Selector is now available from Typhoon Air Conditioning Company, division of Hupp Corporation, Brooklyn, N. Y. . . . . (40) A new line of gasoline-engine driven **generating sets** of 35,000-watt capacity has been announced by Universal Motor Company, Oshkosh, Wis. . . . . (41) The Auburn Machine Works, Inc., Auburn, Neb., has converted the International 300 Utility tractor into a **trenching machine.**

(42) A new line of architectural **loudspeaker baffles** featuring wide angle dispersion through a method of rear horn loading is now on the market. It is produced by Soundolier, Inc., St. Louis, Mo. . . . . (43) A new **electronic tachometer** has been announced

how to judge a fluorescent lamp . . . point no. **5**

ask about **COLOR RENDITION**

If you're like most businessmen today, you know how the proper use of color can speed a lagging production line, work wonders with office morale, give merchandise extra sales appeal. What you may not know, however, is that the color of any surface—be it desk top or cabbage leaf, electrical lead or your secretary's complexion—is largely determined by how that surface is lighted. *And* that light just right for Job A may be all wrong for Job B. Westinghouse fluorescent lamps—available in seven different shades of "white" alone—offer you precisely the proper color of light for jobs from A to Z. "You can be sure if it's Westinghouse."

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

Model 41 Unconditionally Guaranteed

eliminate switch failures with THE SWITCH THAT'S always READY

Pampered in production to withstand abuse in use, the Levolier® #41 switch retains its positive action even after hundreds of thousands of pulls. It is unconditionally guaranteed against failure in lighting circuits. Its one-piece molded phenolic case insures better insulation, makes wiring easier. Removal of the mounting nuts lets the mechanism slip out, exposing terminals. A 6 amp "T" 125 volt switch, it is only ⅝" x 1⅜" x 1⅜". Ideal for individual control of lighting fixtures.

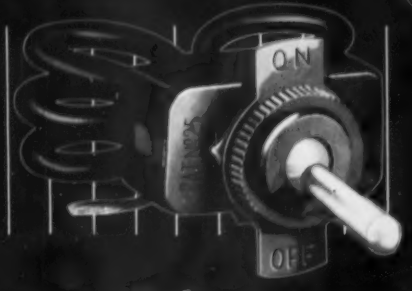
4300-PB 4100

NEW Industrial LAMPHOLDERS with Levolier® Switch Dependability

Whether you prefer universal lever or the new push button control, you can have a Levolier Lampholder that has a proven record of long service in strenuous industrial use. Levolier switch mechanisms are built into both brass and molded phenolic heavy duty lampholders in a variety of single or two circuit models. All are built to eliminate failures in plant and machine lighting that can mean costly production time losses.

only McGILL makes Levolier® Switches

Levolier® No. 25



Specify Levolier for Dependability in Toggle Switches

The Levolier® No. 25 Toggle Switch is "T" rated for 6 amps — 125 volts and especially dependable for FHP motors on quality appliances, portable tools and for panel boards. Only ½" thick, ½" wide and 1" long. The molded phenolic case is dust and vibration proof. 6" wire leads with choice of colored levers for easy identification of circuits. Available also in three way and two circuit models with lugs or screw terminals.

For FASTER, EASIER WIRING specify Levolier® No. 71 switches

A single pole, single circuit switch, the Levolier® No. 71 model is the thinnest 6 amp "T" 125 volt switch on the market today. Only 15/32" thick, it insures quicker and easier installation because of the 6" wire leads that are permanently fastened to the terminals by pressure connections. Standard finishes: brass, dark bronze and burnished nickel, with brown molded phenolic case. The No. 71, like all Levolier switches, is Underwriters' approved.

McGILL®

ELECTRICAL SPECIALTIES

are always a little better and **ALL** *are Underwriters' Laboratories Inspected*

Available through leading Electrical Wholesalers

For complete information on McGill Electrical Products, write today for the new Catalog No. 84.

McGILL MANUFACTURING COMPANY, 450 N. Lafayette Street, Valparaiso, Indiana

by the Standard Electric Time Company, Springfield, Mass. . . . . (44) Atlas Industrial Corp., 849 39th St., Brooklyn, N. Y. has introduced a new **work platform** that accommodates two or more workers.

(45) A new model of the Truco portable **drilling machine**, completely redesigned to accommodate diamond bits up to 14 in., has been introduced by the Wheel Trueing Tool Co., Detroit, Mich. . . . . (46) New mobile **access lifts** for safe working conditions up to 40 ft above floor level have been announced by the Ballymore Company, Wayne, Pa. . . . . (47) A new series of ornamental **pushbuttons**, featuring designs by famous artists and sculptors, has been added to the line manufactured by Rodale Manufacturing Company, Inc., Emmaus, Pa.

(48) The Pump Division of Robbins & Myers, Inc., Springfield, Ohio, has announced a new submersible **pump** for farm and rural installations. . . . . (49) New Barber-Colman tachometer **generators** are adapted from their line of type BYLM permanent magnet motors. They are manufactured by Barber-Colman Co., Rockford, Ill. . . . . (50) Ohio Brass Company, Mansfield, Ohio, has announced that aluminum Strateline **clamps** for deadending distribution lines now feature a keeper piece attached to the U-bolts.

(51) The Smith-Gates Corporation, Plainville, Conn., offers "Central Cooling" **attic ventilation**. . . . . (52) Collins Machinery Corp., Los Angeles, Calif., has introduced a newly designed Thred-O-Matic "22" portable pipe, conduit and bolt **threader and cutter**. . . . . (53) American Blower Corp., Detroit, Mich., has announced new Model CA Ventura **attic fans**.

(54) Frigid, Inc., Brooklyn, N. Y., has announced the new reversible **window ventilator** with automatic thermostat . . . . . (55) Steber Manufacturing Co., Broadview, Ill., has introduced a new series of **Utilities** with aluminum housing for PAR-38, R-40 lamps, Series 12. . . . . (56) American Blower Corp., Detroit, Mich., has developed a new series of Class 2 adjustable speed Gyrol **fluid drives** for 1 through 25 hp applications.

(57) A new **time switch**, Weather-Chron, that automatically regulates the hours of building heating has been developed by Automatic Devices Co., Inc., Western Springs, Ill. . . . . (58) A new pocket size **wire cutter and stripper** featuring a wire size adjustment has been announced by the Jo-El Company, Cleveland, Ohio. . . . . (59) A single-circuit momentary-contact **switch** featuring a normally "On" position is now available from the McGill Manufacturing Co., Inc., Valparaiso, Ind. . . . .

(60) A new residential **garage door operator** is now available from H. W. Crane Company, Maywood, Ill. . . . .

ANNOUNCING . . .
New Remington Cartridge-Powered Tool for Stud Fastenings

REMINGTON 'MIGHTY MITE' STUD DRIVER sets a stud a minute in steel or concrete!

Here's the "MIGHTY MITE"—small but powerful partner of the full-size Remington Stud Driver—the answer to any job requiring a ¼" diameter stud. It's the perfect tool for builders, light contractors and the "do-it-yourself" market . . . can be rented or purchased. You can buy it for *only $34.75!*

The "MIGHTY MITE" has only three parts to handle . . . easy to load and operate. The upper assembly is unscrewed, the 22 caliber cartridge with the desired ¼" stud is inserted, and it's ready to go. One rap of the hammer on the firing pin, and "MIGHTY MITE" rigidly anchors wood sections or steel fixtures to concrete or steel! No pre-drilling required.

Safe, too. It's non-tilt—cannot be fired at an angle; cocks only when held in the proper firing position; must be pushed firmly into position to expose the firing pin. A four-inch-square guard provides full protection to the operator.

Send for the facts about the REMINGTON "MIGHTY MITE"—small, powerful and ideal for your construction job—at the lowest possible price—

ONLY $34.75

Another great NEW cartridge-powered industrial tool by

Remington

DUPONT

Industrial Sales Division, Dpt. ECM-7
Remington Arms Company, Inc.
Bridgeport 2, Conn.

Please send me your free booklet which shows how I can speed the job and save with the new Remington "Mighty Mite" Stud Driver.

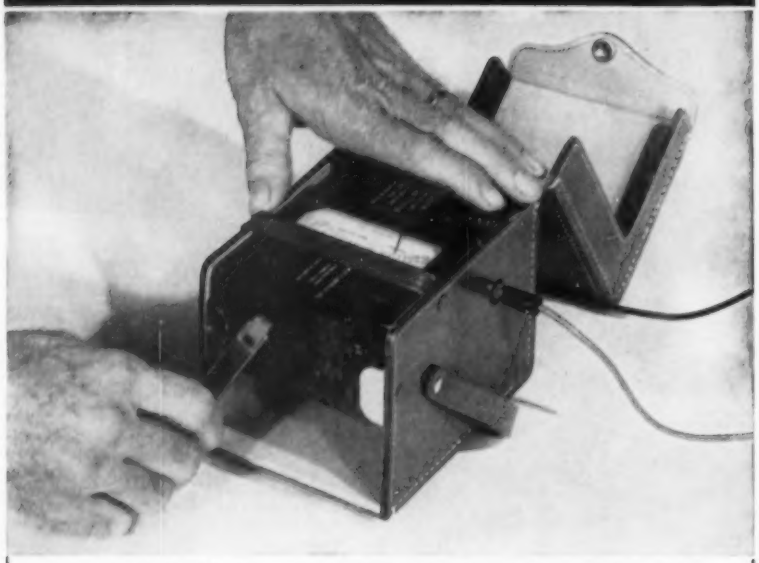
*Name*_____ *Position*_____

*Firm*_____

*Address*_____

*City*_____ *State*_____

BIDDLE *Instrument News*



ELECTRICAL CONTRACTOR DEVELOPS BUSINESS WITH MIDGET "MEGGER"® INSULATION TESTER

Eighteen months after his purchase of a Midget "Megger" Insulation Tester this contractor wrote:

"It seems strange that we were ever able to do business without it. We use it on practically every job that comes into our shop, and on the customer's premises. It has stood up beautifully and does more work than any tool in the shop. Through its use it made possible about $30,000 worth of rewiring during the past year.

"We are able to show our customers grounded conditions while heretofore we could only tell them about bad conditions that existed."

For Convenience and Protection . . .

MIDGET "MEGGER" INSULATION TESTER

Operated without Removing from the Case

The Midget Megger Insulation Resistance Tester is a compact and rugged little set for detecting and diagnosing faulty insulation before serious and costly damage occurs. It is shown here in a "camera-type" leather case which permits operation without removal from case. The test leads store in the bottom of the case. For rugged shop and field use this sturdy "package" is hard to beat. Ranges up to 50 megohms, 500 volts d-c. Low cost.

Write for BULLETIN 21-85-ECM

It's so easy to be sure—

JUST BE SURE IT'S BIDDLE

8603

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

CATALOGS and BULLETINS

(61) FAN AND MOTOR BASES and vibration mountings are detailed in 4-page folder FR-55. Finnflex units are recommended for disturbing frequencies of above 750 cycles per minute. Fan bases provide integral isolating unit for fan and its motor. T. R. Finn & Co., Inc.

(62) FLUORESCENT LIGHTING. Two bulletins. The new Fluoroflood unit designed for outdoor billboard lighting is described in 8-page GEA-6436A. Costs and application data are included. Latest technical and selection information on complete line of lamp ballasts is presented in 12-page bulletin GEC-983H. General Electric Co.

(63) FIBRE CONDUIT. Uses and advantages of both direct-burial and concrete-encased fibre conduits for underground installations are covered in 12-page catalog 52. Orangeburg Mfg. Co., Inc.

(64) MERCURY VAPOR LIGHTING for industrial installations is discussed in a new booklet. Advantages of mercury units, comparative costs, and use of mercury units with other light sources are covered. Sylvania Electric Prod. Inc.

(65) CABLE TROUGH. Catalog 102, 24 pages, gives description of available components of the Sturdi-Built system including unique boltless splice plate for joining elements. Chalfant Products Co., Inc.

(66) RESIDENTIAL HEATING UNITS of the radiant glass panel type feature built-in deflector top to improve efficiency, also slimmer dimensions in flush mounting models. 4-page bulletin. Continental Radiant Glass Heating Corp.

(67) FHP MOTORS, blowers and fan blades are listed in manufacturer's 4-page folder 190-A. Redmond Distributors, Inc.

(68) METER SOCKETS. Bulletin GEA-5878B, 20 pages, contains all basic selection and wiring data on a complete line, including high capacity units for 480-volt polyphase systems. General Electric Co.

(69) LIGHTING in New York Coliseum is described in a 4-page booklet. Eleven units are listed with dimensions and descriptions of their applications in the new showplace. Frink Corp.

New Du Pont "Mylar"
REG. U. S. PAT. OFF.
adds improved qualities to
pressure-sensitive tape
Pressure-sensitive tapes made with new Du Pont "Mylar"* polyester film are giving superior performance in a wide variety of diversified electrical uses. That's because tapes made with "Mylar" offer long-lasting strength in conjunction with chemical resistance, high dielectric strength and thermal stability.
Whether it's holding leads or bundling wires, pressure-sensitive tapes made with new Du Pont "Mylar" increase efficiency and improve performance while helping decrease weight and size.
Du Pont manufactures only the base material, "Mylar". The various firms that make pressure-sensitive tapes using "Mylar" offer a variety of gauges, widths and types of adhesives. Send in coupon below for names of manufacturers and the new booklet listing properties and applications of pressure-sensitive tapes made with "Mylar".
Thin, yet strong . . . gives a snug wrap over irregular, bulky surfaces.
Amazing dielectric strength, thermal stability, for countless electric uses.
Dimensionally stable, can be used over a wide range of temperatures.
Can be metalized, printed, used for coding pipes and wires . . . decorative effects.
Resists edge fraying, has great tear strength... is ideal for tough jobs.
Resists effects of corrosion and moisture over wide range of temperature and humidity.

Registered Du Pont trademark for its brand of polyester film

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT
MYLAR®
POLYESTER FILM

☐ Please send me further information on the basic properties of "Mylar."

☐ Please send me your new booklet on pressure-sensitive tapes made with "Mylar" and names of manufacturers.

E. I. du Pont de Nemours & Co. (Inc.)
Film Dept., Room EC-7, Nemours Bldg., Wilmington 98, Del.

Name _____

Firm _____

Street Address _____

City _____ *State* _____

These beautiful, shallow, narrow recessed fluorescents solve your problem where studs or joists interfere with placement. Ideal, too, for creating attractive slender architectural lines. A companion line of incandescents, the 600's, also available.

- **Low cost, high quality**
- **Exclusive 1-piece piano hinged frame — no ugly mitered corners**
- **Easy-open Alkco pinch-spring**
- **Glass, plastic or louver bottoms**
- **Underwriters' Labeled**
- **Stock widths available, 5", 8", 12", 24"**

Send for Descriptive Folder

ALKCO MFG. CO.

A wide variety of stock incandescent and fluorescent fixtures — recessed or surface mounted — plus highest quality custom work too!

4242 N. Lincoln Ave. • Chicago 18, Ill.

(70) BRONZE BEARINGS. Stock List S-56, 20 pages, gives dimensions of 1050 self-lubricating sleeve, thrust and flange bearings ranging in size from ½- to 4-inch inside diameter. Amplex Div., Chrysler Corp.

(71) MOTORS. Three bulletins. GEA-6341, 8 pages, discusses design features and maintenance of 1- through 30-hp induction motors for hazardous locations. DC Kinamatic motors, rated 1-150 hp, are detailed in 12-page GEA-6355 which includes complete design, selection and application data. Kinamatic dc generators are the subject of 6-page GEA-6461. General Electric Co.

(72) FANS AND SHUTTERS for a variety of commercial and industrial applications are listed in new 8-page 1956 catalog. Frigid Inc.

(73) RECESSED LIGHTING. Section 20 of the manufacturer's catalog has been revised to include suggested methods for installing troffers or incandescent units in 63 ceiling systems. Day-Brite Lighting, Inc.

(74) TV ANTENNA SYSTEMS. Catalog 257, 8 pages, describes a complete line of outlets and accessories relating to antenna installation. Javex.

(75) WIRE AND CABLE FITTINGS. Combined 44-page product listing and 24-page price list offers selection data on a complete line of copper, aluminum, and copper to aluminum connectors, terminal lugs as well as grounding fittings and compression connectors. Jasper Blackburn Corp.

(76) TROFFERS requiring only 2⅞ in. of head space above face of ceiling are available with choice of three diffusing media. 4-page Thin-Lite folder gives complete photometric data and dimensions. Lighting Products Inc.

(77) GROUND DETECTORS will locate accidental grounds in normally ungrounded power circuits up to 600 volts, ac or dc. Portable Brunt Faultfinders, available in three models, operate without interruption of service. Parr Mfg. Corp.

(78) WELDING EQUIPMENT Buyers' Guide, designated GEC-1033, covers all types of ac and dc welding machines, electrodes and accessories. 20 pages. General Electric Co.

(79) TRANSLUCENT CEILING. Specifications, photometric data and installation tips of the Acusti-Luminous Ceiling are presented in a 16-page booklet. Luminous Ceilings Inc.

(80) INSULATING MATERIALS for high temperature use are described in 4-page folder on Class H insulations. Silicone wire, tape, sleeving and tubing are listed and compared with similar insulations in other classes. Insulation and Wires Inc.

(81) GYMNASIUM LIGHTING is the subject of a booklet prepared by lighting engineer J. S. Frizzell. Basic design considerations; selection of incandescent, fluorescent, or a combination lighting system. 12 pages. Pittsburgh Reflector Co.

(82) RADIANT HEATING CABLES for ceiling or floor installation are detailed in 24-page manual on selling, design and installation. Comparative cost chart points up economic advantages of this heating method. Ceilheat, Inc.

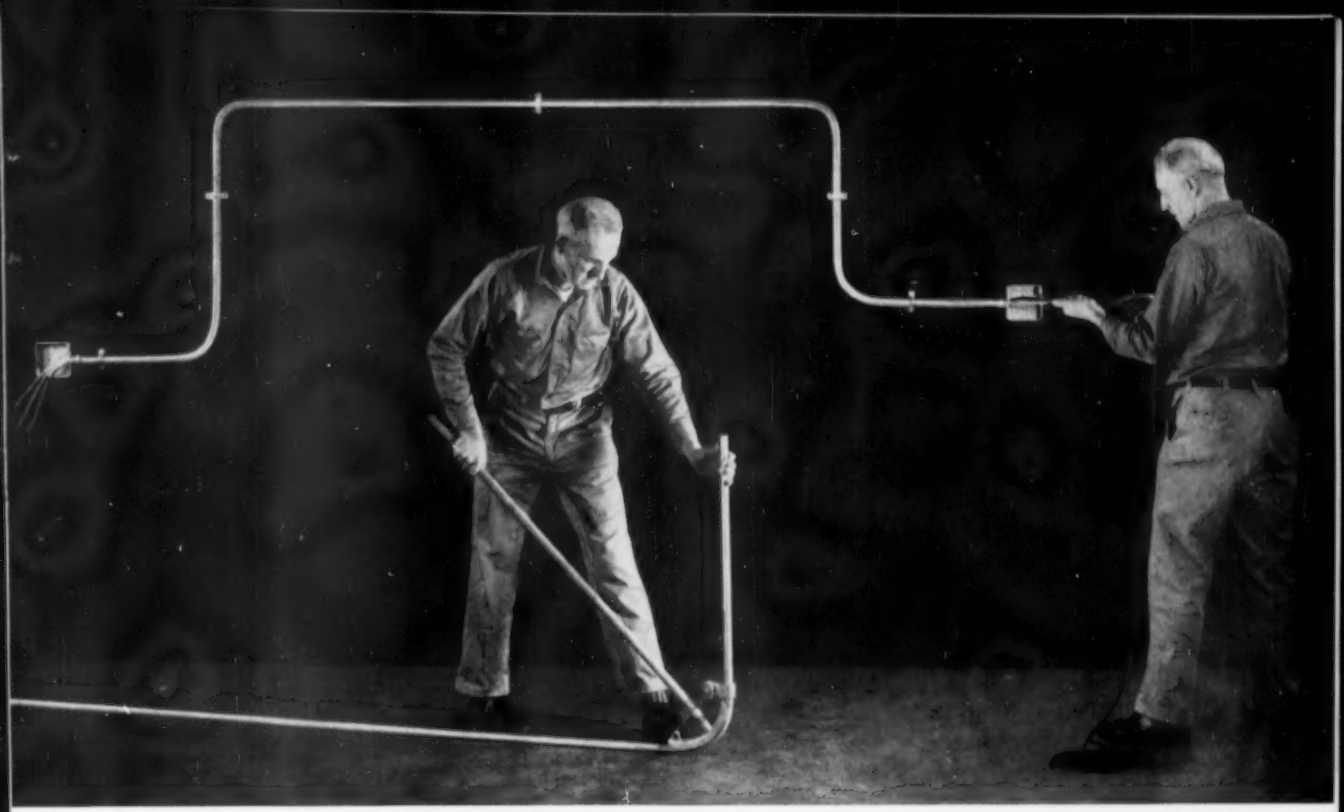
(83) POWER PANELS. Bulletin VBP-460, 20 pages, describes components, layout calculations and specifications of the Vacu-Break line of fused panels, available in ratings up to 600 volts. BullDog Electric Products Co.

(84) INDUSTRIAL EQUIPMENT. Four bulletins. GEA-6215A, 16 pages, covers ac Strongbox solenoids; Germanium rectifiers, their characteristics, construction and applications are discussed 10-page bulletin 1204. Car-bottom electric furnaces are outlined in 4-page GEA-4068A, while GEA-4073A gives basic information on rotary-hearth furnaces. General Electric Co.

(85) POWER TRANSMISSIONS, designated Maureymatic, provide speed adjustment for machines using up to 10-hp V-belt drives. Selection data for the four available styles is given in 12-page booklet. Maurey Mfg. Corp.

(86) FLUORESCENT LUMINAIRES for surface or pendant mounting are available in 2-, 3- or 4-lamp units to accommodate either rapid-start or slimline lamps. All-steel, louvered unit comes in lengths from 48 to 96 inches. Form 540 E, 4 pages, also lists matching incandescent Spot Box. Smithcraft Lighting Div.

(87) DISTRIBUTION TRANSFORMERS. Bulletin 61B6726B covers new electrical and mechanical features of redesigned transformers for rural service. Optional accessories include Thermalite overload indicator and built-in surge protection. Allis-Chalmers Mfg. Co.



Bend without flattening, pull without snagging with General Electric EMT

Continuous weld seam on G-E EMT makes installation easier

Because the continuous weld seam on General Electric EMT eliminates weld metal, there are no burrs to snag conductors or tear insulation. General Electric's strong welded seam won't split or cause flattening during bending. *Controlled, continuous induction welding makes the difference.* G.E. adopted induction welding because it eliminates the sewing machine-like "stitch" produced by other types of welding. Induction welding means easier handling and faster wiring. General Electric EMT also offers these additional advantages:

COLORED BUNDLING TAPE for quick indication of size.

EASY BENDING because only the finest cold-rolled steel is used.

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FIND OUT how you can speed your wiring jobs with G-E EMT. See your General Electric Construction Materials distributor or write Section C60-718. Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

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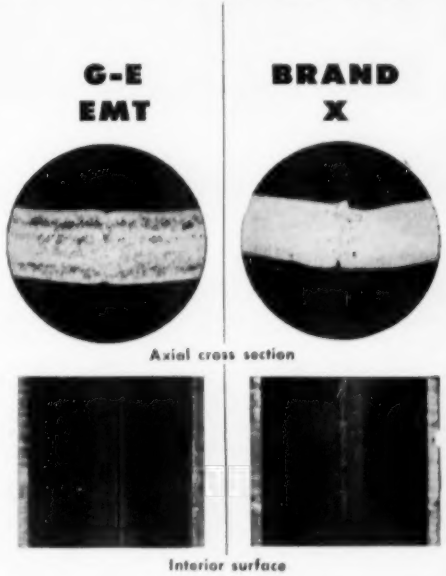

You can see the difference in these photographs. Compare axial cross section and interior surface of G-E EMT (left) with competitive brand (right). G.E.'s smooth weld is produced by continuous induction welding—and only General Electric EMT has it.

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Booster Transformer For Heating Load

QUESTION D30—Recently I have checked a 3-phase plastic machine and found the motors were not at full efficiency. The motors were wound for 240 volts. The 3-phase was fed from the secondary of a 4-wire star, supposed to deliver 208 volts. However, I checked the voltage to be only 200 volts. That is quite a drop from 240 volts to 200 volts. The heating elements were 15 kw at 240 volts, single phase and the voltage was 200 volts. It has been suggested that we place a booster transformer on the single phase for the heaters. The current on the heaters is 65 amps, but they are not operating efficiently. Is there an equation to figure booster transformer size required for the heaters?—V.S.

ANSWER TO D30—There are four major items which will determine whether a transformer is adaptable for use as a booster for a certain circuit. These items are

1. Transformation ratios
2. Voltage rating of the primary winding
3. Current-carrying capacity of the secondary winding
4. The polarity of the transformer being used.

From the description of your trouble it would appear that a 3-phase bank of 1½-kva transformers having a ratio 10 to 1 or 2300 to 230 volts would be the nearest standard transformers which might relieve your trouble.

You need a voltage boost of 40 ÷ 200 = 20% in each phase. The above bank will give you a 10% boost in each phase or 220 volts. This bank will also carry 10 x 1½ or 15-kva per phase. A 440- to 110-volt transformer bank would give you a boost of 25% which would be too high.

Transformation ratio (high side voltage rating ÷ low side voltage rating) will determine the amount of voltage boost (or buck) that is possible with a certain transformer. The voltage rating of the primary winding must be equal or greater than the voltage of the circuit which is to be boosted. For instance, a 2300-volt circuit would require a transformer having a 2300-volt primary. However, a 2300-volt transformer could be used as a booster in a 480-volt circuit. The current carrying capacity of the low voltage or secondary winding determines the amount of kva which the transformer may safely carry as a booster. The secondary winding of the booster must carry full load current of the circuit which is being boosted. This kva is equal to the kva rating of the booster transformer multiplied by its ratio of transformation. Thus a 5-kva transformer with a transformation ratio of 10 will carry 50 kva as a booster.

The scope of this answer is too limited to explain the various methods used to determine polarity of a transformer. However, this can be found in most Electrician's Handbooks. Additive polarity is used in most all distribution transformers.

Fig. I shown below gives the proper connections for use with a single transformer having additive polarity. If the same connections were used on the high voltage side of the transformer and the connections on the low voltage side were reversed, the booster would then act as a bucking transformer. The result would be a reduction in voltage of 10% on the load side of the "booster". Fig. 2 shows a 3 phase, Y connection for a bank of booster transformers.—W.E.N.

Single Phase Connections for Transformer Having Additive Polarity, Used as a Booster

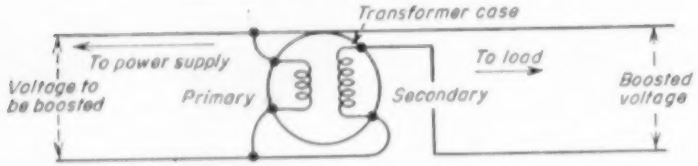

Fig. I

3-Phase, Y-Connection Using Booster Transformers

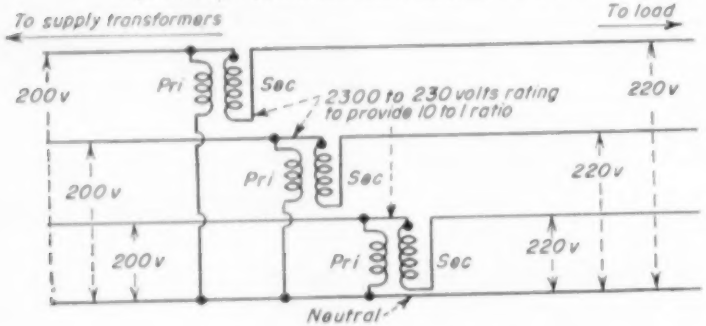

Fig. 2

Protecting Motor Against Single-Phasing

QUESTION E30—How can I protect a 220-volt 2-hp motor when a main fuse goes out? The 110-volt lights on the blown fuse side of the system feed enough power to overheat the motor but not to burn out the fuse.—H.S.

ANSWER TO E30—There is no adequate way to protect both the single-phase motor and a lighting load connected on the same fuses, as you describe. This is because the current requirements of the two circuits are different.

The proper way to connect this circuit is to connect the lighting load on the live side of the motor fuses, and protect the lighting load with its own fuses. Then a blown

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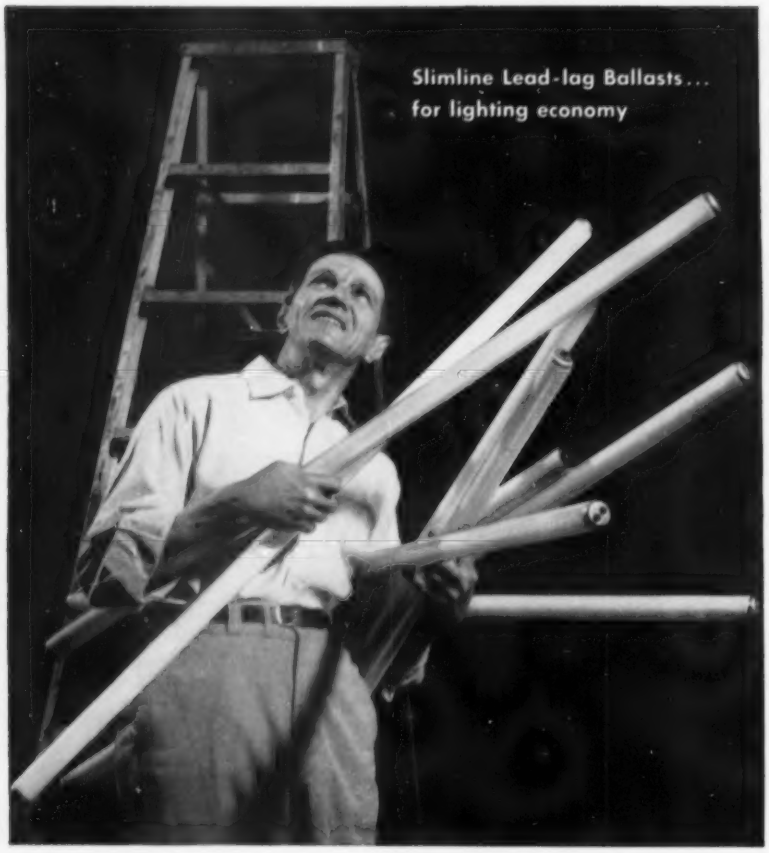

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fuse in one circuit does not affect the other.—E.A.M.

ANSWER TO E30—You evidently have a 110-volt and 220-volt 3-wire system. I assume you have the correct size fuse in the motor to protect it from overheating when it is running on 220 volts at its usual speed. Your motor is evidently the self ventilating type and emits a breeze when running. Where the fuse (main) blows the motor comes to a stop or maybe slow speed if dc. A circuit is formed from neutral wire through lights to the side of 3-wire system fuse has blown through motor to the other side of 3-wire system. Since the motor is not being ventilated when stopped it will take less current to overheat the motor and therefore the motor fuse will not blow. It will only blow if its current rating is exceeded. You evidently have no undervoltage release on motor starting device or it is set too low.

A thermal cutout (thermostat) mounted against motor frame or winding and its contact connected in series with motor will open the circuit if set to operate when the motor overheats. If you do not want lights to go out on blown fuse side, connect a small undervoltage relay at a convenient location to 220 volts. The contacts are connected to a bell and then to a few dry batteries. This will give you warning and allow you to replace fuse and isolate or convert trouble before motor overheats or open motor switch if you need more time.—E.B.

ANSWER TO E30—The best way of correcting this situation would be to install a 3-pole circuit breaker. The cost is low and operation positive without worry of any single phasing as described. There are numerous small types advertised in E.C.&M. among them ITE, Square D, General Electric Company, Westinghouse Elec. Corp. and others. The fact that all lines are opened at once in the event of a fault prevents the trouble described. —C.O.D.

Effects of Single Phasing of Motor

QUESTION F30—After a 40-hp 3-phase 440-volt motor had been single-phased for some time, the motor was extremely hot and smoked quite profusely. The load was removed, and in applying the

current, it would draw 200 amps per leg, with a loud noise as it rotated. This happened several times then finally it returned to its normal current characteristics of about 9 amps, no load current. Could it have been a rotor scraping after the extreme heat of being single-phased or what would make the noise as it rotated with the high current consumption?—E.S.H.

ANSWER TO F30—The possibility of a rotor scraping is very likely especially under heavy loads. Circumstances prevailing at the time may have bent the shaft enough to cause a scraping effect on the part of the rotor because of the heavy load. Upon removal of the load and under no load conditions the shaft may be aligned properly.

This then gives rise to other possibilities. The bearings may be worn thereby letting the rotor scrape under adverse conditions. Also the bearings may be underlubricated causing a binding action thereby giving the impression of a scraping rotor since the sound is transmitted along the shaft length.

Finally, foreign particles may have entered the housing and lodged therein. This would also indicate a scraping rotor. After the foreign matter was dislodged the motor acted normally.

Tests on a dynamometer could be run to duplicate the condition and observing operating characteristics. Then the end balls and bearings should be checked thoroughly. Finally the rotor and stator should be observed for any scrape marks or embedded particles.—J.B.K.

Silicone Grease For Power Tools

QUESTION G30—In our plant we have considerable trouble with grease running out of transmissions of electrical tools of many types. Is there a good silicone grease on the market today that would remedy this trouble? If so, what is the name of it?—M.D.

ANSWER TO G30—Silicone greases are designed to reduce the rate of deterioration in high temperature applications. The trouble in your plant is undoubtedly due to present or past overlubrication of bearings in conjunction with ruptured grease seals, if such seals are present. Repair seals, if any, and reduce the quantity of grease

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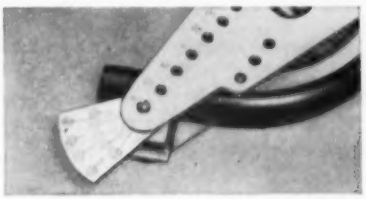

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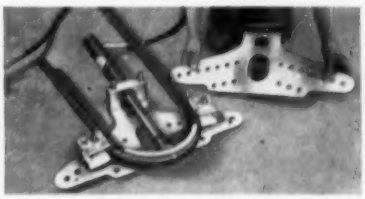

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inserted and possibly the frequency of lubrication. Consult one of the reputable lubrication companies for help.—J.S.

ANSWER TO G30—There are on the market several types and grades of grease which would be helpful in overcoming your problem. The general tendency is toward silicone greases because of their outstanding qualities and properties. Among the excellent properties are a low change of viscosity with temperature, low freezing point and stability to heat. Perhaps the most outstanding property is its chemical inertness.

Since there are several grades available, the manufacturer of your apparatus should be consulted. Then you can compare his recommendation with various chemical companies which produce silicone greases.—J.B.K.

Stress Cones At Cable Terminals

QUESTION H30—What is the purpose of a stress cone installed at terminations of a shielded cable? What could be expected of the cable if the stress cones were left off? —H.G.R.

ANSWER TO H30—The purpose of a stress relief cone is to increase the puncture strength of the insulation by reducing the concentration of electrical stress at the ends of the shield. The cable would be likely to fail at the ends of the shield without them.

Throughout the length of a high-voltage shielded cable, the lines of electrical stress are *evenly* distributed under the shield. Where the grounded shield is cut back to make a termination, however, the stress lines in the portion of cable without shielding bend back toward the end of the shield and add to those directly under the shield. The resulting dense concentration of flux lines in this small area results in high electrical stress and may cause insulation failure and cable puncture.

This concentration of electrical stress may be reduced by building up a double cone of additional insulation, with metallic shielding extending up to the middle of the cone. Insulating tape is wound around the unshielded portion of the cable until an apex is built up about 3 to 4 in. away from the end of the shield. Then copper tinsel

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braid is wrapped evenly over the tape from the apex to the end of the shield where it is soldered.

Manufacturers of cable and cable terminators furnish kits for preparing stress relief cones, together with the necessary information giving the proper dimensions which vary depending upon the operating voltage and service conditions. Shielding is generally recommended for most cables rated 5 kv and higher.—R.G.O.

ANSWER TO H30—The purpose of a stress cone at the termination of shielding is to build up the insulation to a greater thickness to prevent a breakdown at that point of greatest stress. If the stress cones are left off where the shielding ends, ozone will form which will attack the braid and the insulation, and eventually break down the insulation, resulting in a rupture.—W.R.S.

Can You ANSWER These QUESTIONS?

QUESTION T30—Recently I was asked to change a 220-volt, 3-phase, 1-hp motor to 220-volt, single phase. I have tried most everything, changing the coils so they are north and south, leaving some out, etc.

Is it possible to use a capacitor by using some coils as starting coils or could I rewind the motor as regular single-phase coils and start winding but with a manual switch? —R.W.D.

QUESTION U30—In our plant we many times experienced the difficulty of fused safety switches heating at the various joints within the switch. One engineer said, "If you would go to a heavy duty safety switch, you would no longer have this difficulty." Another engineer said, "This would not help because the only difference between the standard and heavy duty switch is the case and locking mechanism." Which engineer was right?—M.D.

QUESTION V30—Referring to hot and cold cathode as applied to fluorescent lamps, I have heard it stated that a cold cathode actually dissipates more heat than a hot cathode. If this is so, the nomenclature hot and cold cathode is misleading. Can someone explain? —R.E.B.

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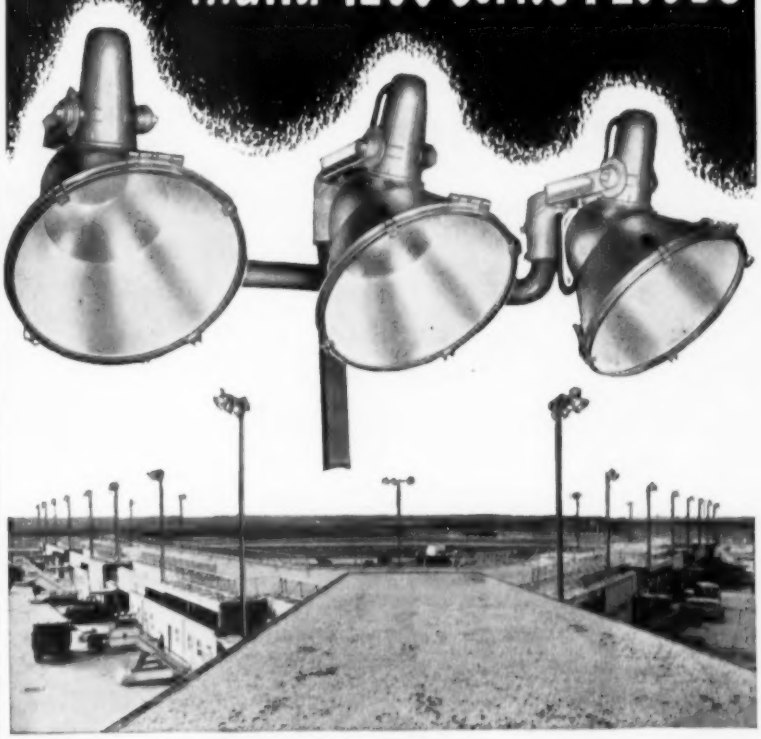

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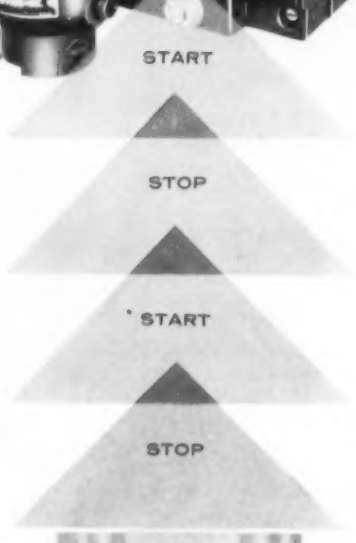

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Questions on the Code

Answered by

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

Locations of Motor Disconnects

Q. *This problem concerns what the Code considers the controller for electric motors—the magnetic starter or the momentary pushbutton station (start-stop station) that controls the magnetic starter. It seems that either would be considered the controller under the definition of controller preceding Section* 4381. *In the diagrams illustrated below it is assumed that the disconnect shown by an x is not capable of being locked in the open position. In Fig.* 1, *would the disconnect be located at location* 1 *or* 2? *In Section* 4409 *it states that the disconnect shall be located within sight from the controller location. If the momentary pushbutton is considered as the controller then it would have to be at location* 1 *and if the starter is considered the controller it would have to be at location* 2. *If the momentary pushbutton in Fig.* 1 *is considered the controller location and the disconnect switch located at* 1 *as required, it seems that in order to comply with* 4386 *a switch would also be required at location* 2, 3 *or* 4 *as shown in Fig.* 1. *If this were the case, would the switch at* 2 *or* 3, *as required by Section* 4386, *be required to be horsepower rated (5 hp motor 3-phase)? In Fig.* 2 *the same question arises as to what is considered the controller. The components are the same as in Fig.* 1 *but the arrangement is a little different as shown.—F.D.*

A. The definition of a controller given by the fine print preceding Section 4381 indicates to me that the device which actually disconnects the motor from the circuit is the controller. In this case the magnetic starter shown is the controller. The pushbutton station is merely a means of operating the magnetic starter or controller. In view of the foregoing, it is my opinion that the location of the disconnecting means specified by Section 4409 would be at the point marked (2) on your diagram. The same reasoning applies to the circuit shown by Fig. No. 1-A. In this case the disconnecting means should be located at the point marked (1) on your diagram but the magnetic starter must be located as shown in Fig. No. 1. I do not believe that the Code ever intended that disconnecting switches must be installed within sight of the pushbutton location.

Section 4406 requires the disconnecting means to disconnect both motor and its controller from all ungrounded conductors. A switch in the control circuit as proposed would not satisfy this requirement. Section 4386 requires the motor to be within sight of the controller location or arranged to be locked in the open position. I believe these rules, with the recognized exceptions, are intended to assure that when the disconnect is in the open position all of the wires at the control, the control circuit and the motor will be disconnected. The only exception is covered by Section 4374 which recognizes an additional switch when the control circuit is energized from a separate source of supply.—B.A.McD.

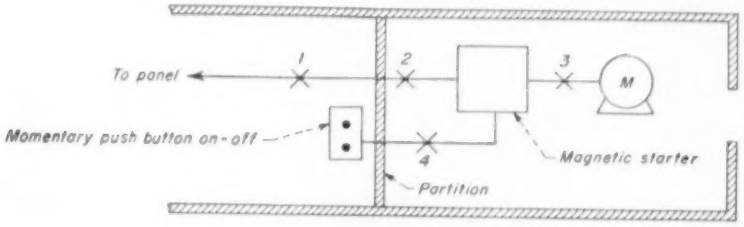


Fig. 1

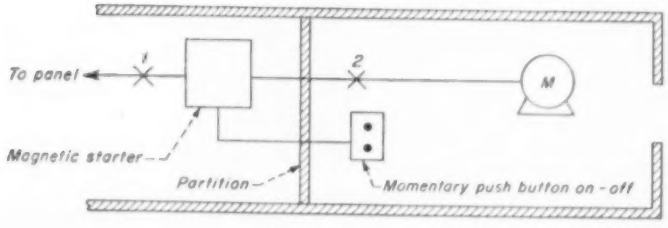
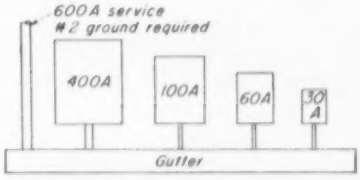


Fig. 1-A

Service Grounding

Q. *What size bonding conductor is required to bond these switches and gutter?—C.H. C.H.*



A. Your diagram does not state whether or not the service contains a neutral. From the fact that you state definitely that a No. 2 grounding conductor is required I would have to assume you are using an ungrounded system, and are basing this size on the table in Section 2595.

This may be wrong—and here again I would make an assumption—if this represents a service center as would be indicated by the fact that you show the main conduit at the entrance at the extreme left as a "600-amp service". For a 600-amp service with a common grounding conductor you would use the Table in Section 2594a, and without a grounded neutral with a

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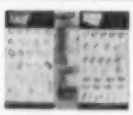

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service equipment grounding conductor only, you would use the table in 2594b. The table in 2595 is for use for the determination of the grounding conductor size for interior raceway and equipment and not for service equipment.

So on the basis of the above being a service installation, we would have to have three 1,500 mcm RH, or six 500 mcm RH in a single conduit, or two conduits with three 350 mcm RH in each, to obtain a 600 amp service. According to the Tables in 2494 (both are actually the same for a copper wire grounding conductor) we would need for the

a. 1,500 mcm, a 3/0 conductor,

b. two 500 mcm, or 1,000 mcm equivalent, a 2/0 conductor, or

c. two 350 mcm, or 750 mcm equivalent, also a 2/0 conductor.

Since bonding is still part of the service grounding conductor, it would have to be the same size, i.e., 3/0 or 2/0 depending on the service conductors used.

If the above actually is just a distribution center and fed from a 600-amp feeder branch, then we would use the table in 2595. For a 600-amp overcurrent device ahead of this distribution center, a No. 2 copper wire is sufficient. However, a separate grounding conductor would not be required, unless this is an isolated center which is not tied into the main system by conduit or other recognized metal raceway which can serve as the means for bonding.

You will note that a ¾-in. conduit would serve in this case (column 3 from left of Table in 2595), and with a 600-amp feeder conduit I am sure there would be more than ample bonding capacity available.—B.Z.S.

Inductive Heating—AC Conductors in Conduit

Q. *On a recent job in a large industrial plant, there were large concentrations of control wires in a common gutter. On the particular load center where we did considerable work it was noticed often times a small shock could be felt on the circuit we were working on even after the power on that particular circuit had been shut off. Also striking the wire against a grounded enclosure would make a small arc. There was not enough voltage present to make a reading on the common type field voltage tester commonly referred to as a "wiggie". We were careful to adhere to the Code rule of keeping all polarities in the same raceway. We felt the small shock felt was inductance and capacitance because all the other control wires in the common gutter were energized.*

Then came the occasion to work an another load center which also had large concentrations of control wires and most of the work had been done by another crew. It was noticed that almost all the control wires here were giving the shock as described. It was also noticed that the control wires went into whatever raceway was the handiest without regard to the rule of keeping all polarities in the same raceway. This crew felt that the small currents carried by control conductors would not heat the raceway by induction. True the raceways were not even warm, but I feel this condition had something to do with the many "hot" control wires in that particular load center. (We never put a voltmeter on them to see what voltage was present; it was just enough to make it miserable to work on).

The Code states in one place that 50 amps or overall polarities must be in the same raceway to cancel each other out and in another place it mentions that all polarities of 3- and 4-way lighting must be in the same raceway; however in the latter case seldom will be the case on 3- and 4-way lighting that the current is ever 50 amps. In most cases it will probably be little more than an amp. It seems that the Code is somewhat conflicting here. All of the control circuits mentioned here in the common gutters with raceways extending out to certain locations would each be carrying a fraction of an amp.

Another question I am not clear on concerning this same problem is the use of single conductor mineral insulated metal sheathed cable. Here is just one conductor with no others to cancel out the inductance if it is enclosed in a metal raceway. It seems to me there is the possibility of induction in this case.—G.R.G.

A. Insofar as the Code requirements are concerned I do not believe there is any conflicting provisions concerning inductive heating as indicated in your question. Section 3018 of the Code, which covers this subject, provides two separate provisions for safeguarding the hazards which result when ac conductors are not properly arranged to avoid overheating

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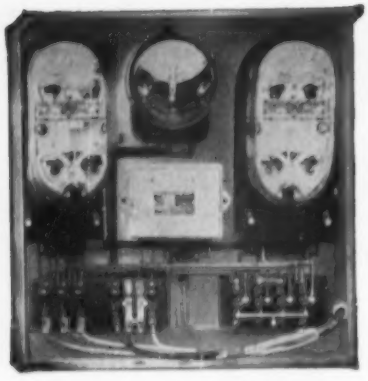

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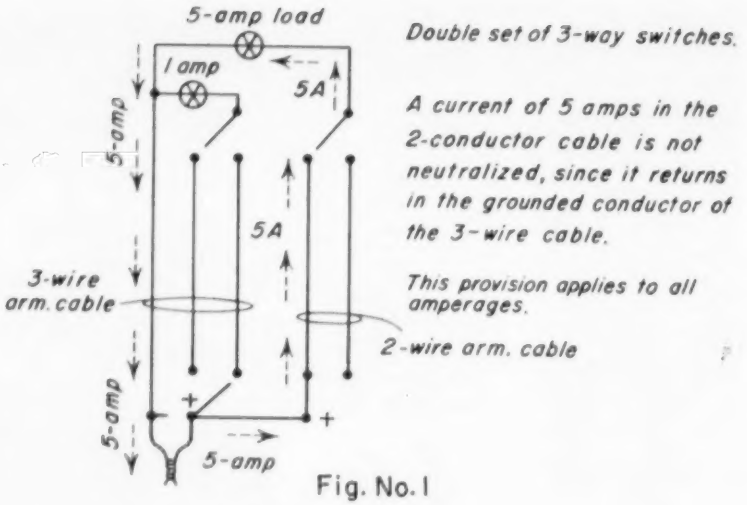
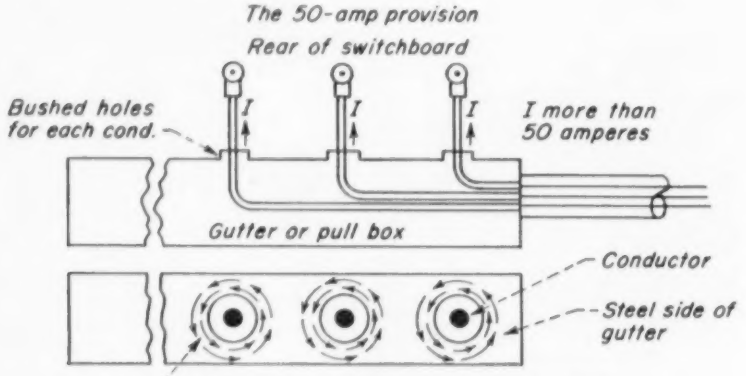


Fig. No. 1



Magnetic field produced in metal cover. Resulting current creates heat. Heat damages conductor insulation. Slots cut between holes break field circuit. Use of insulating block eliminates field.

Fig. No. 2

of the metal by induction. The first provision requires the conductors of an ac circuit which are run in a metal raceway or cable armor to be so arranged as to avoid overheating of the metal by induction. This rule is not limited to circuits carrying more than 50 amps. It applies generally to all circuits regardless of the amps involved except for circuits supplying vacuum or electric discharge lighting systems or x-ray apparatus or signs and also under-plaster extensions, Article 344, as covered by the fine print note following this Section 3018. The current involved with the use of some of this equipment is measured in milliamperes, which is not considered of sufficient importance to warrant recognition under this rule. Section 3802 definitely requires the conductors of 3-way and 4-way switch circuits to be arranged to avoid inductive heating, and this rule applies regardless of the load controlled. It could be a 60-watt lamp or a 30-amp branch circuit.

The second provision covers the case where a single conductor carrying more than 50 amps enters a metal enclosure. The details involved are covered by the third fine print note following Section 3018. This is the provision which only applies when the current involved is more than 50 amps. One of the applications of this provision could be at the rear of a switchboard where the mains or feeders are brought to the rear of the board through an auxiliary gutter to the switches on the board. Under such conditions, I know from actual experience that considerable inductive heating will result in the metal where the conductor leaves the gutter. As explained in note 3, the condition may be remedied by cutting slots in the metal between the individual holes or by bringing all of the conductors involved through a single insulating block with in-

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dividual holes for each conductor. I have endeavored to clarify these two Code provisions by the illustrations shown in Fig. No. 1 and Fig. No. 2.

Since both of these provisions concern only the inductive heating of the metal wire enclosures, there still remains a question concerning the potential that existed on a circuit when it was disconnected. If all of the other conductors in the conduit were so arranged to neutralize the inductive effect of each circuit it appears to me that this would not be the cause. If not so arranged, an induced current under certain conditions could be imposed on the disconnected conductors.

Section 3301 of the Code recognizes a single conductor Type MI cable and there appears to be no restriction with respective use for either ac or dc circuits. When used on dc systems the question of induced currents is eliminated. When used on ac systems there is a considerable distinction between the induced currents on a sheath which is highly magnetic and one that is not. Iron and steel are highly magnetic while copper, of itself, is not so considered. It therefore follows, when a single conductor is enclosed in a steel conduit or raceway the magnetic field in the steel will be very strong. The same conductor with a sheath of copper and lead, which are not usually considered magnetic metals, would not produce a similar field.—B.A.McD.

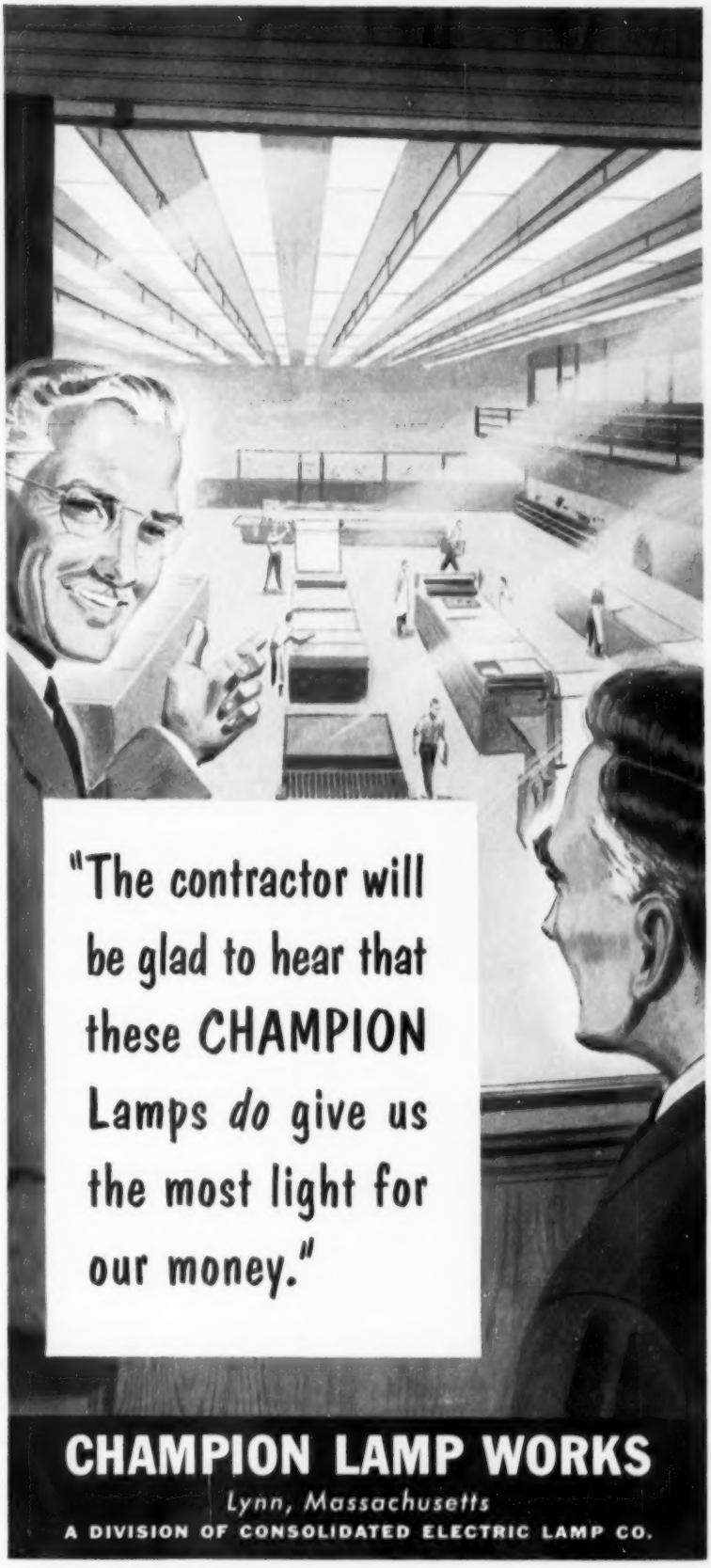
Six Disconnects of Service

Q. *Under the grouped disconnects part of the NEC you are allowed to have up to six disconnects for the entire load.*

1. *Do two or three parallel wired, main-range panels grouped in a single family residence comply with the Code?*

2. *Can you use say, two safety switches, two pull outs and two sets of circuit breakers, grouped and comply with the Code?—J.R.W.*

A. Basically, I would say yes to both questions. In either case you have a maximum of six subdivisions of the service. You have them grouped. The fact that you are mixing up the types of disconnects, while may not be good engineering or may not look very good (but this cannot be helped sometimes) still does not violate any code requirements.—B.Z.S.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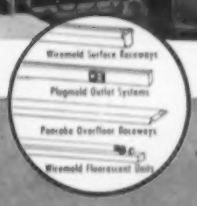

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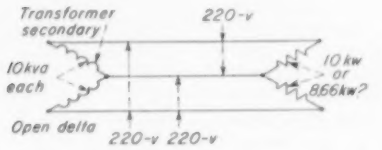
Open Delta Transformer Capacity

Q. *If an open delta bank of transformers supplies an open delta bank of heaters, can the open delta bank supply only 58% of a full three-transformer bank and not 66⅔%; or only 86.6% of the two-transformer bank capacity—P.P.G.*



A. An open delta bank of transformers has a transforming capacity of 57% of a full three-transformer bank. This is 85% of two-thirds.—B.A.McD.

Exit Light Circuits

Q. *Where main switch is at building entrance and distribution panelboard is at remote location, can exit light circuits be tapped on main lugs in distribution panelboard?—Z.B.*

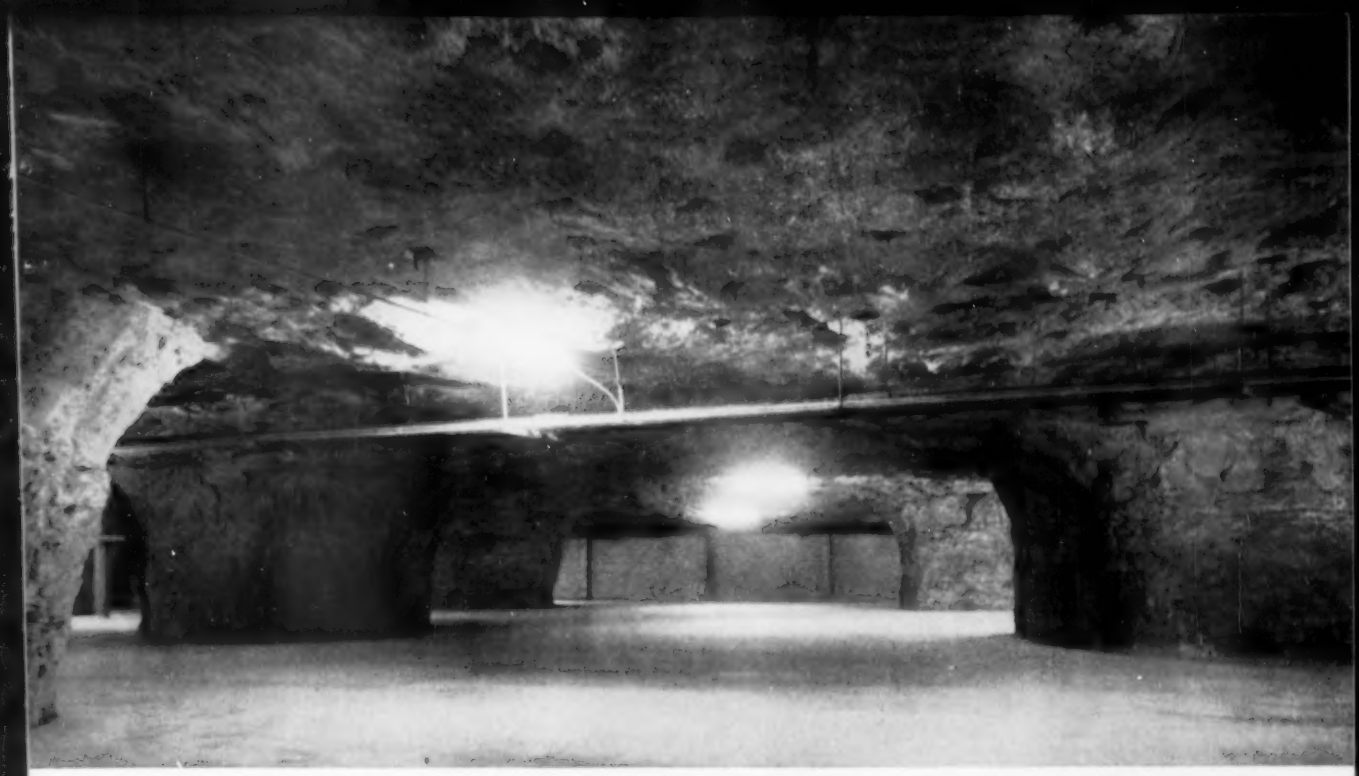
A. The Code only provides for a tap for "Emergency service" ahead of the service disconnecting means (see 7015). Such a system as you describe would not satisfy the intent of the Code since anything that would cause the main service switch to open would also affect the emergency system so that no emergency service would be available.—B.Z.S.

Service Main Disconnect

Q. *A service panel contains a 400-amp main breaker and the following circuits: one 400-amp, one 150-amp, one 100-amp, two 60-amp, and a spare. What advantage, if any, is the 400-amp main? —E.R.*

A. There is, of course, only one advantage: you have a single switch controlling all the load. This advantage is a moot one and in my opinion is far outshadowed by the many disadvantages such a system offers.

First off, you limit the entire service, far below its capabilities. You have a capability of 400 plus 150 plus 100 plus three times 60 amps or 830 amps. Even with some



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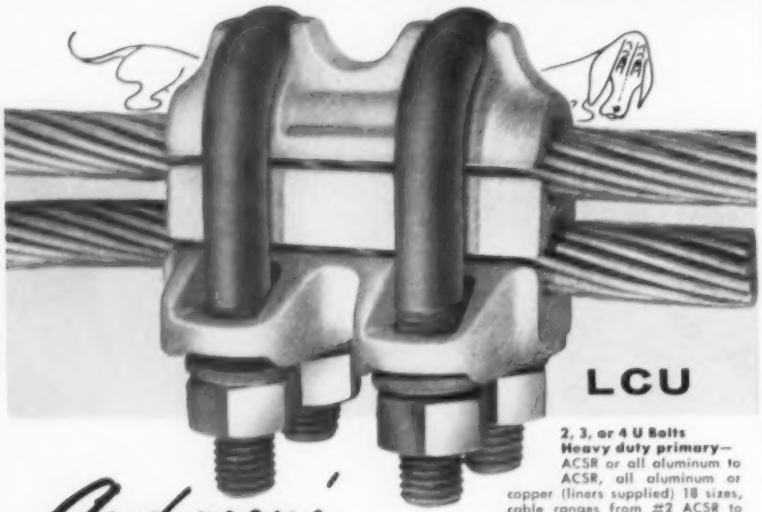

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reduction for motor starting, we could expect a goodly portion of this capability for actual loading.

The one possibility, where each branch supplies a single motor, would make this installation feasible perhaps. Under these conditions we would actually have for full voltage starting of each motor an actual loading equal to about ⅓ of this capability, so that the full load running current would be about 830/3 or 276⅔ amperes, well below the rating of the main.

Then, it is very seldom that operating maintenance conditions require a complete shutdown of the system. As a rule only one circuit is required for shutdown at any one time.

If the main breaker is installed for interrupting capacity, then it is not necessary to do so, since it is possible to obtain in each individual branch circuit breaker sufficient IC rating, even with molded case combination (with high IC fuses) breakers. These are now available, in general, up to 100,000 amps IC.

Since the code permits up to six subdivisions of service, there is, as a general rule, no advantage to using the main. The discussion above is far from a complete one and I feel sure there are many other points that can be brought out. I should also point out that many inspectors will not concur in these opinions, since there is a definite feeling on the part of many of them that we should again require a single disconnect for all services.—B.Z.S.

Conduit Fills

Q. *Does footnote to Table 4 of 1953 Code refer only to rewiring or to any service, new or old?*

Another question—May Tables 11, 12, 13, and 18 of the 1953 Code be used in figuring wire size that may be used in an existing service conduit run?

It is my belief that 1-in. conduit may be used for service on new construction as per footnote of Table 4 and on rewiring we are not limited to 2 insulated 4 and one bare 4 for service but may use maximum size conductors as may be figured out according to Tables 11, 12, 13 and 18.—R.L.W.

A. The footnote following Table No. 4 Chapter 10 permits a service run of 1-in. conduit or electrical metallic tubing, which does not exceed 50 ft in length and does not have more than the equiva-

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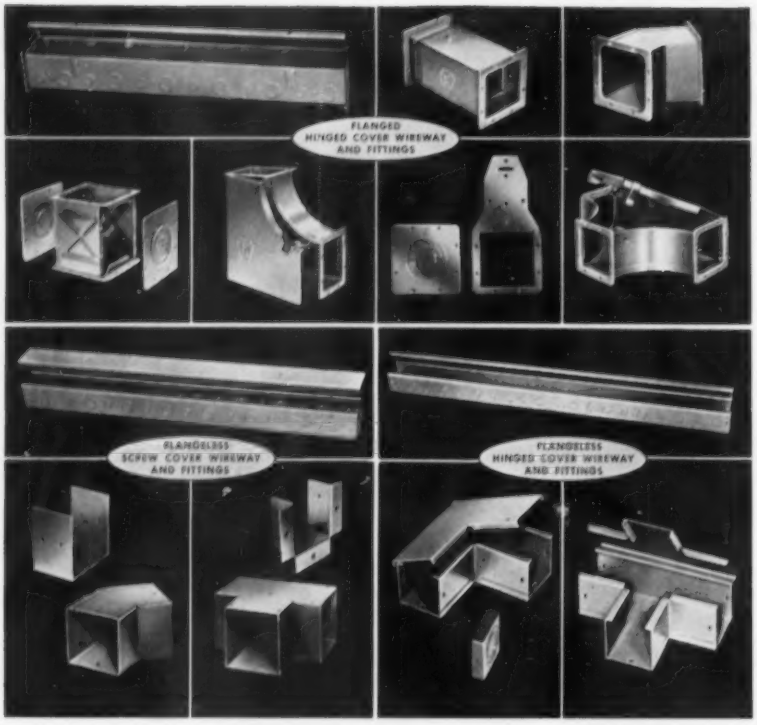

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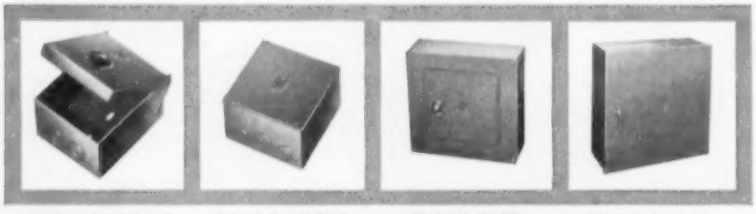

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lent of two quarter bends from end to end, to contain two No. 4 insulated and one No. 4 bare conductors. This is recognized for either new or old work and is not limited to rewiring. It appears to me that this note is not necessary, since Table No. 11 recognizes combination of conductors not included in Table No. 4. In the case presented we have a combination of conductors where two are insulated and one not insulated. Table No. 4 covers insulated conductors. Applying Table No. 11 we may, for three conductors, have a 43% conduit fill. According to Table 13 a No. 4 conductor has an area of .1605 sq in. and according to Table No. 18 a bare No. 4 conductor has an area of .042 sq in. The total area of the three conductors is .363 sq in. 43% of the area of a 1-in. conduit is .37 sq in. (Table No. 12). It is evident from these figures that the conduit fill recognized by Table No. 11 is satisfied.

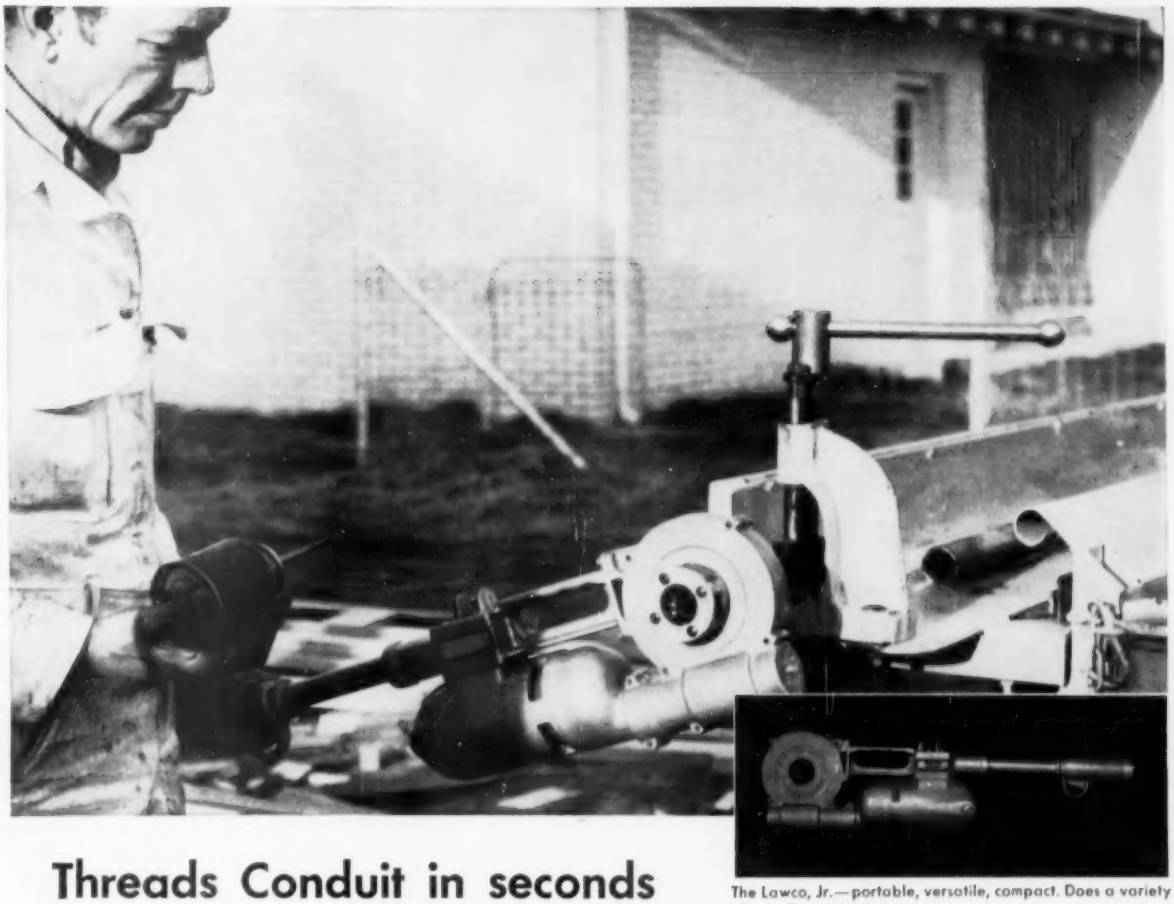
In reply to your second question you could not use the 50% fill recognized for rewiring existing raceways unless this service raceway satisfied the limitations involved by Table No. 4. Official Interpretation No. 286 issued February 14, 1947 advises that this provision applies to concealed raceways. If the service you have in mind is installed open on the side of a building it may be easily removed and replaced with a larger service. As I recall the original intent of this provision was to facilitate the rewiring of the building by the use of conduit which was buried in masonry or otherwise concealed.—B.A.McD.

Emergency Lighting

Q. *Two sockets are required for exit light fixtures; why not two sockets for emergency light?—L.M.*

A. The Code does not specify any number of sockets. This is usually set up in the requirements of a separate municipal or state law or ordinance. Since exit lighting is part of the emergency lighting it should be the same for both.

Thus, for example, if you are going to use an incandescent fixture for general lighting and it has two or more lamps in the fixture, you may select one or more of these fixtures for emergency lighting. The fixture should be rewired so that at least one or more of the



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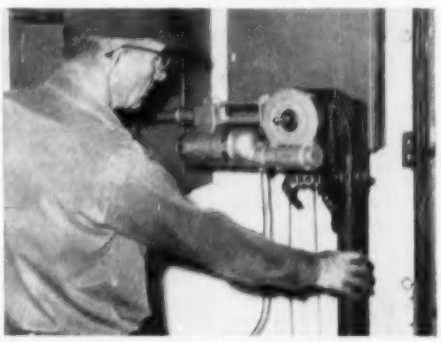

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lamps is fed from either system if both systems operate simultaneously. The fixture may be a standard type if the two systems operate from a transfer switch.

Just what type of fixture, how many, the specific branch circuitry, etc., is not a function of the National Electrical Code.—B.Z.S.

Concealing Seal Fittings

Q. *In your July* 1955 *issue, the article entitled "Gasoline Pumps and Seals" discusses the fact that sealing fittings can be concealed. In the same article you mention Official Code Interpretation No.* 369, *issued April* 18, 1951, *applying to operating rooms. Could you inform us as to the content of Official Interpretation No.* 369? *Our main question is, will the Code allow us to use concealed sealing fittings under Article* 500 *for wiring in a hazardous area where combustible anesthetics are used in a hospital? We would appreciate information on the above subject.* —*D.G.W.*

A. Official Interpretation No. 369, issued April 15, 1951 is quoted as follows:

"Section 5015—Seal Fitting.

"Statement: A lighting circuit switch in a concealed conduit below the five foot limit from the floor of a hospital operating room, is installed in a Type EFS condulet fitting. Located above it in the conduit run is an external sealing fitting, such as Type EYS condulet.

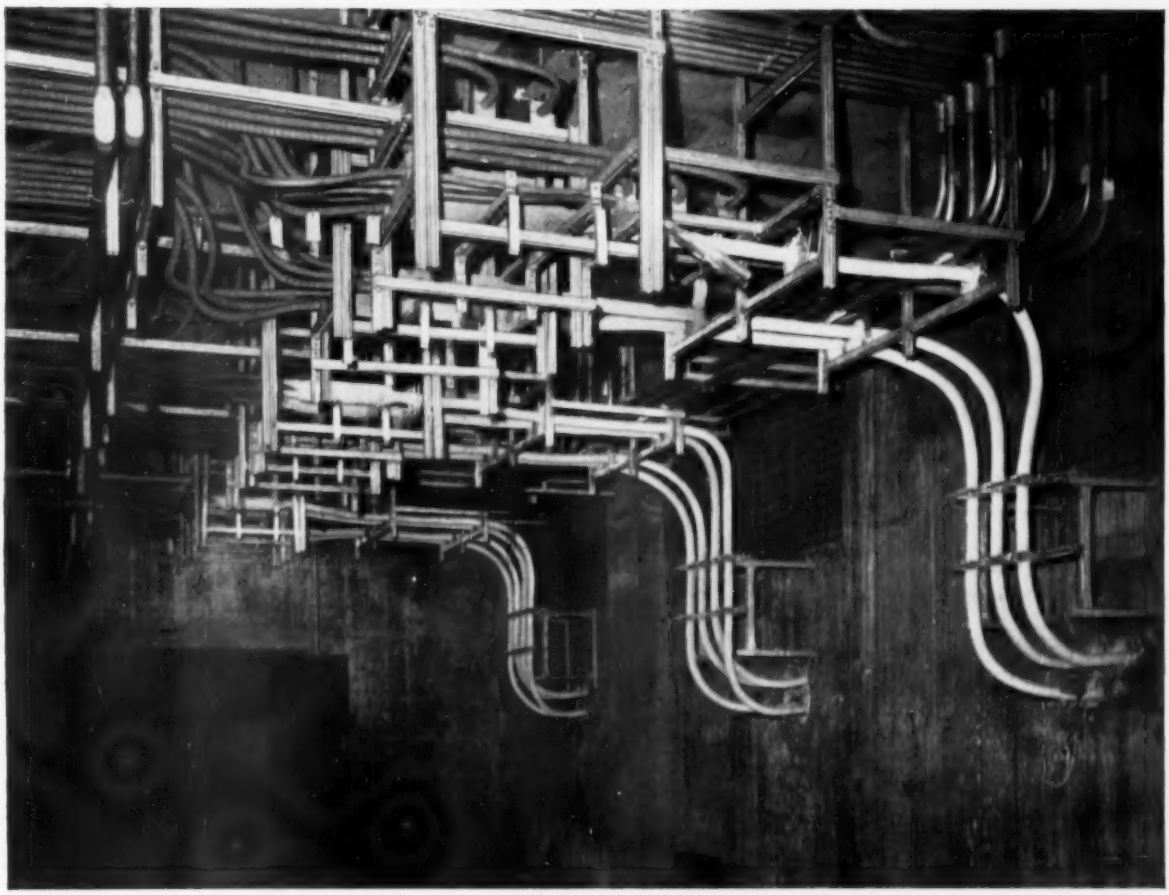
"Question 1: Does Section 5015, paragraph a, sub paragraph 1, and paragraph c, require the use of the second and sealing condulet (Type EYS) not withstanding its position must make it concealed within the building structure?

"Answer: YES.

"Question 2: Will a seal in the conduit entering this switch box, employing a nonhardening compound inserted into the conduit raceway from the switch compartment, serve as an acceptable substitute for the sealing condulet and compound specified in section 5015 paragraph of c?

"Answer: NO."

It appears to me that this interpretation recognizes the use of a sealing filling concealed in the wall and Section 5135(e) covering combustible anesthetics in a hospital occupancy requires sealing (Section 5105-e) as covered in Section 5015 of Article 500. Since this interpretation was made in 1951, I have



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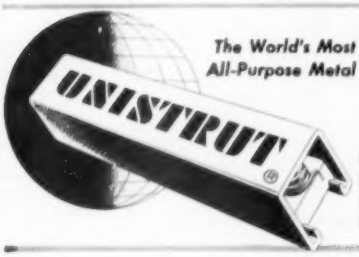

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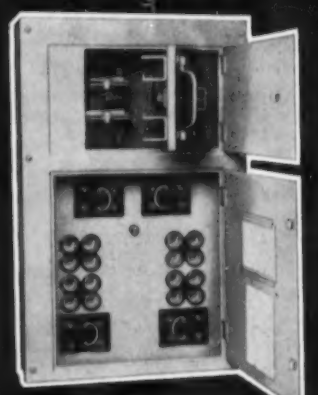

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reviewed the provisions of the 1953 Code covering Section 5015 and find that this interpretation still applies. I have also reviewed the proposals for changes in the 1956 Code and find no proposal that would alter this interpretation.—B.A.McD.

Installing Motor Generator Set

Q. *I am installing a small motor generator set to supply direct current to some office machines here in the city and it seems most practical to mount this generator set in the penthouse on the roof of the building immediately above the office where the machines will be installed. Air ducts extend out from this penthouse to many different points about the roof of this building and then down through that roof to various points within the office in which these machines will be located. As one of these ducts extends to a point immediately above the location of these machines, we would simplify our job and also do the least damage to the finish within the office if we could run a 1-in. conduit through this duct from a panel box in the penthouse to a panel mounted on the wall behind the machines. Would this be in violation of any Code rule?—E.A.S.*

A. Section 3020 of the Code permits the installation of a circuit within an air conditioning duct provided the circuit is contained within rigid conduit, flexible steel conduit with lead-covered wire or Type ACL armored cable with suitable fittings for the location. Therefore it would be possible for you to run a conduit through this duct extending from the penthouse on the roof to the office on the top floor immediately below. However, inasmuch as this raceway will be exposed to different temperatures, Section 3015 will make it necessary that you seal the conduit to prevent circulation of air from a warmer to a colder section and if this air conditioning duct has a damper where it passes through the roof of the building, it will, of course, be necessary that the conduit be so installed that it will not interfere with the operation of this fire damper. If the air conditioning system supplies only the top floor of the office building in question, it is unlikely that a damper will be found; but if the

air conditioning system supplies more than the top floor, then standards covering air conditioning installations would make mandatory the use of a fire damper in any duct which would make possible communication of fire from one floor to another.—G.R.

Wiring Gutters

Q. *Where in the Code will one find the requirement concerning wiring gutters or side wiring space in a cabinet or panel?—M.H.*

A. This requirement will be found under paragraph c. of Section 93732 of the Code. This section reads as follows: "Cabinets and cutout boxes which contain devices or apparatus connected within the cabinet or box to more than eight conductors, including those of branch circuits, meter loops, sub-feeder circuits, power circuits and similar circuits but not including the supply circuit or a continuation thereof, shall have back wiring spaces or one or more side wiring spaces, side gutters or wiring compartments."

Then under Section 3736 you will find a requirement governing the width of wiring gutters for conductors of No. 1 or larger.—G.R.

Emergency Lighting

Q. *May the emergency circuits supplying emergency illumination in a school auditorium be controlled by 3-way switches with one switch mounted at the control panel for the stage and the other switch mounted in an accessible location adjacent to the main entry to this auditorium?—D.W.*

A. Section 7041 of the National Electrical Code prohibits the use of 3- or 4-way switches for the control of emergency illumination. Where two or more switches are desired in order to control a single circuit from two or more locations, such switches should be of the single throw type and should be connected in parallel and at least one of these switches must be accessible only to authorized persons. Additional switches which act only to put emergency lights into operation but not disconnect them may be located anywhere within a building.—G.R.

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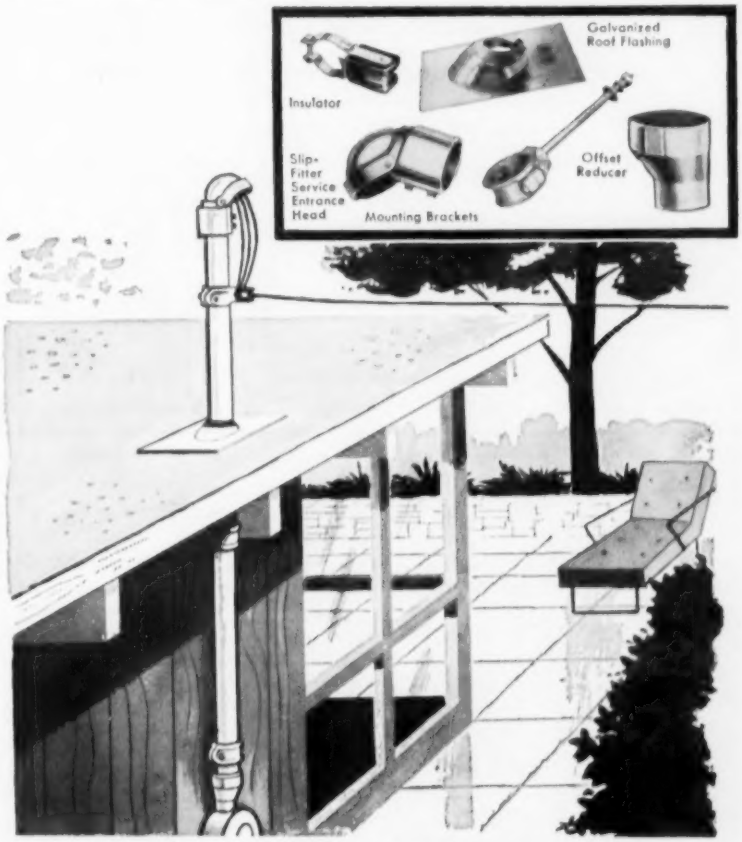

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The Blackhawk Service Entrance Mast is available in complete kits or as separate fittings. Whichever way you buy, either the complete kit or individual fittings, the name to remember in service entrance masts is Blackhawk.

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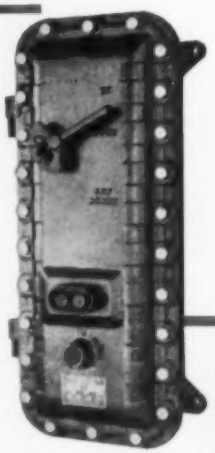

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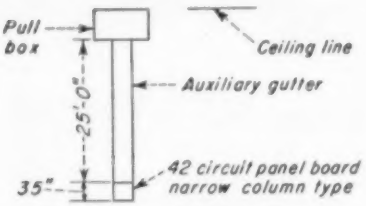
Panelboard Extension

Q. *When is an extension to a panelboard cabinet a trough or an auxiliary gutter—Article 362, 373 and 374?—E.W.M.*



A. The question would seem to be based on the need for pulling say at least 44 wires in the auxiliary gutter, i.e., at least 2 phase legs—neutral usually carried only from pull box—and 42 branch circuit conductors.

If this is classified as an auxiliary gutter, as you have here, or as a wireway, we are limited to a total of 30 conductors (see Sections 3624 and 3745). In this case I would say you are technically violating the Code if the section between the pull box and the panel is approved by the UL as an "auxiliary gutter".

From a practical standpoint we would not have a bad installation. Let's check for conductor occupancy. For a 42-circuit panel, 3-wire, 125/250-volt, single phase, we could feed with two 250 mcm conductors. Assume that the 42 branch circuits will be No. 12. The total wire occupancy would be as follows:

2 x .5917 or 1.1834 sq. in.
42 x .0384 or 1.6128 sq. in

total 2.7962 sq. in.

For 20% occupancy the minimum cross-sectional area of the gutter must be 2.7962/.2 or 13.981 sq in. The gutter will usually run about 8 in. wide by 5 in. deep or a total of 40 sq in. From the standpoint of fill we do not have a bad job.

A review of one manufacturer's catalogue on these items is quite interesting. They show a panelboard available for use on a single phase, 3-wire, 125/250-volt system having 32 branches. With 2 phase wires this would make a total of 34 conductors in the "auxiliary gutter" section. This panel for use on a 3-phase, 4-wire, 120/208-volt system has only 28 branches, so with 3-phase conductors we have a total of 31 conductors.

Using another type of breaker as many as 40 branch circuit conductors may be supplied so we may have as many as 43 conductors in the gutter section.

In one section of this catalogue this "auxiliary gutter" section is called a "cable duct", a term which, per se, is not defined in the Code.

The same manufacturer in a more general listing of these products in another catalogue, states very clearly and specifically, however, that these "cable duct" sections are UL listed as "wireways". Furthermore, they state very clearly that because of this listing the total number of wires must be limited to 30. Yet on the very next page facing this discussion, the catalogue shows that 42-circuit panels are available in this style of construction.

The entire situation is somewhat confused and while the manufacturers do give a complete story and explanation, I know for a fact that jobs have been designed using all 42 branch circuits with the "cable duct" section. I cannot see where any harm is done (except maybe we may have quite a heating problem with so many wires in one raceway) but actually we are violating the Code.

Seemingly, the manufacturer should get a UL approval for the entire assembly as such, and not designate this intermediate section as a wireway, nor as an auxiliary gutter.—B.Z.S.

Panelboard Gutter Widths

Q. *Does Section 3736a apply to panelboard construction?—R.A.P.*

A. Yes, it applies wherever a cabinet of any kind is used.—B.Z.S.

EUGENE J. THER, Ther Electric and Machine Works, Chicago, Ill., and John G. Persson, Electric Apparatus & Repair Co., Philadelphia, Pa., find common problems discussed at NISA's 23rd annual convention in Philadelphia.

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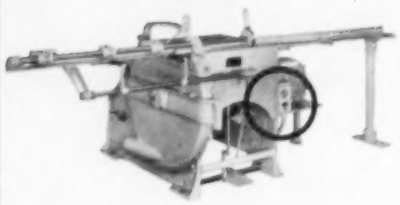
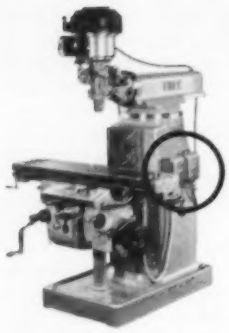
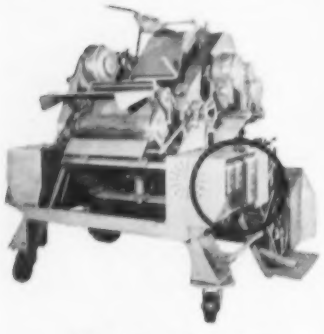
A-B controls on Tabor-Gray Turret Head Nibbler



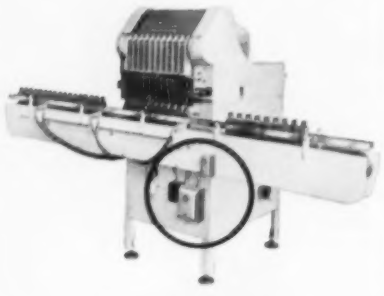
A-B starter on Mereen-Johnson Automatic Cutoff Saw



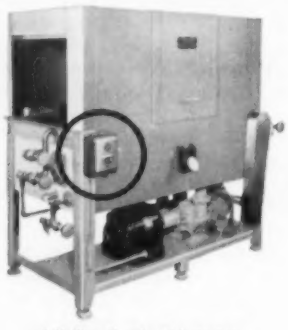
A-B starters on Tree Tool & Die Milling Machine



A-B controls on Royer Sand Separator and Blender



A-B controls on Crandall Tablet Counting Machine



A-B Size 1 solenoid starter on Toledo Dish Washer

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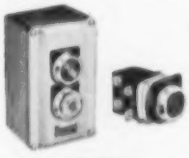
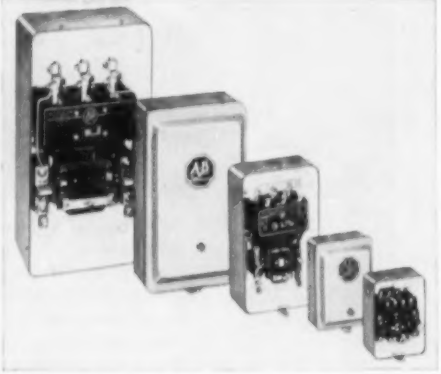


Push Buttons



BULLETIN 709 SOLENOID STARTERS— Sizes 0 to 4. The complete line of Allen-Bradley solenoid starters includes 8 sizes up to 300 hp, 220 v; 600 hp, 440-550 v. Above are shown in NEMA Type 1 enclosures for general-purpose applications. Other enclosures are listed in the Handy Catalog.

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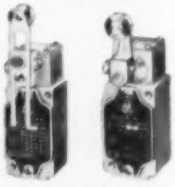

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In The News

Housepower Support Voiced at EEI Meeting

In presenting the Edison Electric Institute "Housepower" program to the 24th annual convention of the association of business-managed electric light and power companies, Harry Restofski, vice president of West Penn Power Co., enlisted a large group of speakers representing companies and associations with like promotional objectives in an impressive display of industry harmony.

The "Housepower" program—

- to mass-educate homeowners on rewiring,
- to stimulate customer action toward rewiring of 20 million homes in 10 years, and
- to assist and support other programs having the same objectives,

—was outlined by Mr. Restofski with other utility executives: Carl T. Bremicker, vice president of Northern States Power Co. and chairman of the National Adequate Wiring Bureau; Paul D. Brooks, vice president of American Gas & Electric Service Corp.; E. O. George, manager of sales, The Detroit Edison Co.; and George Ousler, vice president of Duquesne Light Co.

Explaining how additional industry support will help the "Housepower" program were: Ken Lydic of Owens-Corning Fiberglas; Walter Eichelberger of Philco; Roger Bolin of Westinghouse; W. V. O'Brien of General Electric; Robert Smith of U. S. Steel; E. S. Rising of Kennecott; J. F. Miller of NEMA; and P. Howard Farley of NECA.

Harllee Branch, Jr., president of EEI and president of Georgia Power, saw a "brightening outlook" for the "business managed and tax-paying" utilities in spite of some setbacks in recent political developments.

"Make no mistake about it," he declared. "A new spirit is beginning to move in our industry. It is a spirit of conviction, and of courage, and of cohesiveness too often lacking in earlier years when unwarranted political attacks have been loosed upon us."

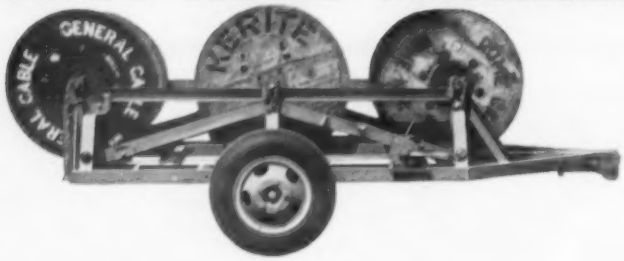
To "know each other and communicate concerning our respective problems . . . is the key ingredient in the improvement of management-union relationships," Mark W. Cresap, Jr., executive vice president of Westinghouse, told the convention. "Ideological chasms between industry and labor are generally obsolete. There are many differences between management and unions today, and it is the very nature of things that there always will be . . . but as to the fundamental goals for the American economy, there is general agreement. Both management and labor want full employment and a rising standard of living."

"We need about twice as many graduates in the physical sciences and engineering as the approximately 45,000 we are producing each year," claimed L. R. Boulware, vice president of General Electric, ". . . but half of the capable and a third of the exceptionally talented are lost during the educational

NEW OFFICERS of National Association of Lighting Maintenance Contractors (NALMCO) for 1956-57 are (l. to r.): Front row—Edward I. Creed, Cleveland, Pres; Herbert Mendelsohn, Kansas City, Mo., Secy-Treas; Robert E. Walton, Denver, Colo., Western V.P; Rear row—Jerome Gimbel, Chicago, Central V.P; Walter C. Fink, Jr., Atlanta, Ga., Southern V.P.; Glen Shatola, Milwaukee, Wis., Midwestern V.P; and Francis Clark, Waterbury, Conn., Eastern V.P.

MINNESOTA ELECTRICAL ASSOCIATION officers elected at recent St. Paul convention include: (L to R) President—Elroy A. Lehn, Anoka; vice president—O. H. Pederson, Moorhead; secretary—Stanley J. Berquist, Litchfield; manager—Carl A. Birk, Minneapolis. The new treasurer is Bert Gordon of Albert Lea.

CABLE REEL TRAILER



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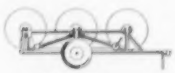
LOADING



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NEW . . . EASY LOADING AND TOWING

One man can easily load and unload heavy cable reels with this winch equipped trailer.

• All welded steel construction • Powerful brakes. • Standard clevis trailing hitch. • 6000 lbs. capacity. • Stop and tail light. • Reels revolve for dispensing cable. • Accommodates reels to 48" diameter x 36" width.

(Other models available to handle larger reels.)

UTILITY EQUIPMENT, INC.

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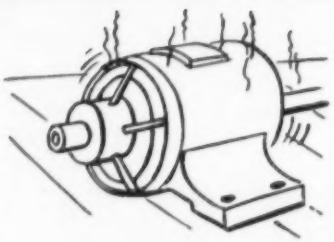
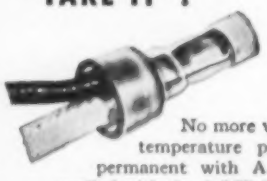
vibration? . . . heat? . . .

A-MP® NYLON CLOSED-END CONNECTORS CAN "TAKE IT"!





No more vibration problems . . . no more high- or low-temperature problems! Pigtail splicing is safe, quick, permanent with A-MP insulated connectors. They're easily applied with the A-MP Super-Champ Hand Tool.

API offices in major cities carry complete lines of A-MP Nylon Closed-End Connectors, Solistrand®, Plasti-Grip®, and Pre-insulated Diamond-Grip Terminals designed to meet the most stringent requirements.

Ask your API salesman about Custom Fitted Terminal Kits. He can supply and service a Kit designed to include only terminals you need.

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process . . . and mostly in the earlier part of it." He described the extensive community activities of his company devoted to increasing the total supply of scientists and engineers.

New officers of EEI elected at the 1956 convention were: president, Donald S. Kennedy, Oklahoma Gas and Electric Co.; vice president, J. Wesley McAfee, Union Electric Co. of Missouri; vice president and managing director, E. Vennard, succeeding Col. H. S. Bennion, who has retired.

Wholesalers Discuss Practices, Outlook

Taking its "Let's Talk Business" theme to heart, the 48th annual convention of the National Association of Electrical Distributors took a healthy look at itself—and listened to a few pointed criticisms from outside distributors' ranks.

NAED, meeting in Atlantic City, heard a contractors' representative say that the distributor is as much at fault as the contractor for bid-shopping and for encroachment upon others' functions. From an economist, the group heard that the business outlook is good but that wholesalers themselves are on shaky ground with excess credit and speculation and, from NAED's executive director, that the electrical wholesaler won't stay on top unless he proves economically most efficient.

Representing NECA, P. Howard Farley, sales promotion manager, said that it is now "almost impossible" to discuss manufacturing, distribution and ultimate sale or delivery to the customer as separate functions.

"Recently, many manufacturers have started duplicating the efforts of the distributor," he commented. "Manufacturers have started call-

C. J. AINSWORTH, Ainsworth Electric Co. Ltd., Toronto; H. C. Blenkhorn, Blenkhorn & Sawle, St. Catherines, Ont. and Arthur G. Bamford, Sutherland-Schultz Electric, Ltd., Kitchener, Ont., Canada.

JOHN P. RYAN, L. J. Land, Inc., New York City, and B. Milton of Empire Electric Co., Inc., Brooklyn, N. Y., at the 23rd annual convention of the National Industrial Service Association in Philadelphia.

ing on your customers, and in many cases, selling direct to them. We know how you feel because you have been doing the same thing to us for a great many years."

Stressing the change in marketing because of the postwar communications speedup and revised manufacturer thinking, Farley concluded that distributors might find their middle position an advantage. "You render a service both to us and to the manufacturer. Perhaps you can be the paramount factor in the readjustment of marketing channels that is coming."

Analyzing the economic outlook for the next few months, Professor Raymond Rodgers, New York University, said that the nation is in a period of "modern-style readjustment". He added that we should be "well on our way again before Christmas".

"Fortunately," Rodgers said, "the American economy is so large and so diversified nowadays that even a 25% drop in automobile production will not throw it into a tailspin. In fact, it will not prevent the Gross National Product for 1956 from rising to the highest level it has ever attained."

He also discussed the problems of electrical wholesalers, emphasizing overt concern with volume at the expense of profits and the tendencies to overindulge in sales financing and inventory speculation. Rodgers said, "If you 'live it up'—that is, permit your expenses and commitments to grow to the point where you *must* operate at 100% of capacity to make a profit, and where you must look to a constant increase in volume as the only means of increasing your profit—you are bound to have trouble when business slackens."

NAED's Executive Director, Arthur W. Hooper, tackling the elec-

United States Steel Corporation • Gary Sheet And Tin Mill
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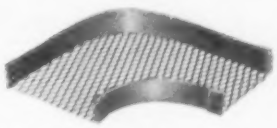
Lower Installed Cost For Industry With Cope Cable Trough

U. S. Steel adopted Cope Expanded Metal Cable Trough for power distribution. Cope Cable Trough *saves labor* during installation because Cope Cable Trough is faster to install—easier to design—than any other cable supporting system. Exclusive Pin-Type Coupler simplifies every connection.

Engineers everywhere are specifying Cope Expanded Metal Cable Trough because it:

Saves Materials • Saves Space • Simplifies Maintenance and Inspection
Permits Higher Cable Current Ratings Improves Flexibility

Specify the new Cope 70,000 Series with exclusive Pin-Type Coupler that greatly reduces installation time



Our engineers are ready to work with you. Write us today for full details on new 70,000 Series.

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New ONAN CCK Electric Plants

MORE OUTPUT *per pound of weight!*

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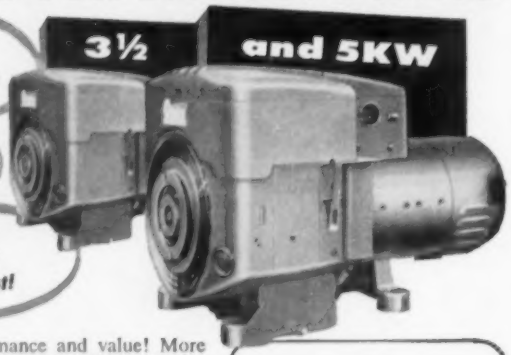
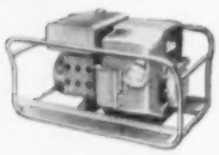
MORE OUTPUT *per dollar cost!*



Way ahead in performance and value! More powerful, two-cylinder, air cooled Onan gasoline engines of 4-cycle, horizontally-opposed design give smooth, quieter, effortless performance. Short stroke and moderate speed cut engine wear, give longer life. Quality features include rotating Stellite-faced exhaust valves, solid Stellite valve seat inserts, full pressure lubrication. Onan's exclusive Vacu-Flo cooling system available for difficult or "buried" installations.

Completely Onan-built, with Onan gasoline engines direct-connected to Onan all-climate generators in compact, rugged units. Available in stationary, portable and standby models with a wide range of accessories.



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Available with carrying frames or 2-wheel dollies. Easily portable. Other Onan portable models: 500 to 10,000 watts.

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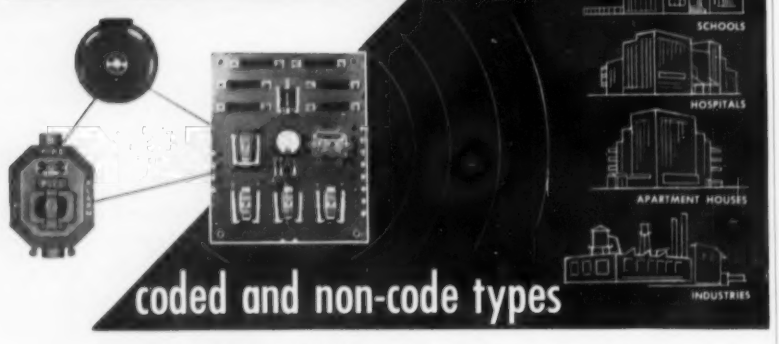
Interior Fire Alarm Systems



coded and non-code types

Complete reliability **is the one thing we demand from a fire alarm system. Therefore, when ordering Interior Fire Alarm Systems, be sure to specify equipment (control panels, stations, and fire alarm bells) produced by Wheelock Signals, Inc., the originators of A-C Fire Alarm Systems.**

Both coded and non-code types are available in various arrangements depending on type of building or establishment. Although Interior Fire Alarm Systems are intended primarily for warning occupants of a building, they can be connected into a municipal system. *Write for Bulletin FA-3*

Engineering representatives in principal cities are available to assist in specifications.

Signal Engineering & Mfg. Co., has changed its name to

Wheelock SIGNALS INC.

FIRE ALARM LONG BRANCH, N. J.

JOHN F. NEIHART, Standard Electric Service Corp., Reading, Pa., and Alfred Elson Jr., New England Machine and Electric Co., Pawtucket, R. I., between technical sesions at NISA convention in Philadelphia.

trical distributor's overall problems, noted that "the one stumbling block in the otherwise happy picture of production and consumption is distribution. The distribution machine must be tuned with production."

Hooper called for a two-pronged distribution program: (1) the need to recognize that distribution, too, must be profitable enough to allow funds for developing new methods, personnel training, and business systems and facilities, and (2) an attempt to find every possible way in which distribution service can be rendered better and at less cost.

Hooper maintained that this "should be an era of satisfaction for the manufacturer, the distributor, the contractor and the dealer. . . . I believe that the same courage and common sense that has built this industry leave no ceiling on how far the industry can advance".

BUSINESS OUTLOOK was compared for East, Southwest, and Mid-West by (l. to r.) Barney Roth, Philadelphia, Gerald Joseph, Albuquerque, and Glen Shatola, Milwaukee, during recent annual conference of NALMCO in Hershey, Pa.

Albert A. Schuhler

Albert A. Schuhler, electrical engineer and author of technical books, died June 16. He was 61 years old and lived in Short Hills, N. J.

Since 1949 Mr. Schuhler was a sales engineer with the New York office of Edwards & Co., covering the New Jersey territory.

He graduated from City College of New York and received his degree at Washington University. In 1925 he joined Stanley & Paterson and stayed with them until the firm was taken over by Schwartz Electric Co. in 1940. In 1942 he left Schwartz to join Federal Signal & Electric Co. as sales manager in charge of war contracts. After the war in 1945, he went with Sperti-Faraday and stayed there until 1949 when he joined Edwards & Co.

Mr. Schuhler was well known as a signalling and communications engineer and for his books on "Electric Wiring". He has also written many articles for *Electrical Construction and Maintenance*, including the section on Signalling and Communication in the Specifications issues and the recent Modern Electrical Systems Design issue.

Housepower Program Started on Long Island

The nationwide Housepower program is off to a strong start on Long Island. A recently concluded series of five meetings held by the Long Island Lighting Co. in different locations throughout its territory for bankers, electrical contractors, architects, appliance dealers and home building contractors was attended by 500 business leaders.

NEW DUO-JOBMASTER®
by
Ramset®

gives you
TWO TOOLS IN ONE!

RAMSET'S new tool has interchangeable barrels, to set either ¼" or ⅜" fasteners into steel or concrete—an added convenience to the time, temper and money-saving advantages of RAMSET FASTENING SYSTEM.

Will do all of your fastening jobs

Operator carries the second barrel in his pocket like a fountain pen, ready to set any variety of fasteners the job may require—light, medium or heavy duty anchoring into hard materials like concrete or steel.

Makes tough jobs easy

No more drilling or chipping; fasteners are set instantly, accurately and permanently with a press of the trigger.

Learn about this low-cost, time-saving, modern way to fasten. Find for yourself what it can mean to any construction job. A demonstration will convince you.

Ramset Fastening System
WINCHESTER-WESTERN DIVISION
OLIN MATHIESON CHEMICAL CORPORATION
FIRST IN POWDER-ACTUATED FASTENING

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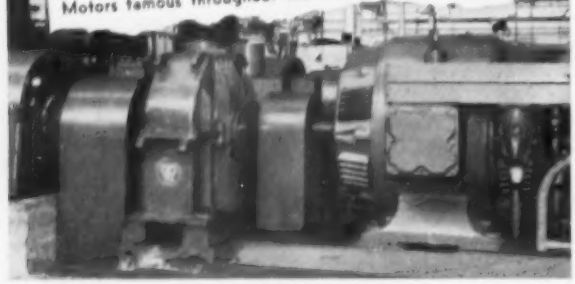
BROOK MOTORS up to 600HP FROM STOCK!

WORLD'S MOST RESPECTED MOTOR

DRIP PROOF AND FAN COOLED TYPES IN EITHER SQUIRREL CAGE OR SLIP RING

NOW you can obtain large motors—up to 600 HP—from stock—there is a Brook warehouse near you—heavy duty motors built for continuous service, with all of the design and construction features that have made Brook A.C. Motors famous throughout the world. SEND FOR DATA.



Open Drip Proof, Totally Enclosed Fan Cooled, Totally Enclosed Non-Ventilated, NEMA "C" and "D" Flange, Extended Shaft Pump Motors, Special Motors, stocked in a wide range of sizes.

FAST DELIVERY OF ALL POPULAR MODELS

Brook Motors are available from warehouses at Chicago, Dallas, Jersey City, Los Angeles, Memphis, St. Paul, Salt Lake City, San Francisco, Savannah, Seattle, Tampa and other major distributing points.

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A financial giant, the new Texas National Bank rises on the fabulous Texas Gulf coast. Marcus transformers provide "money in the bank" dependability for power and lighting distribution. For trouble-free performance and greater profits, choose Marcus for your next transformer installation.

Architect: Kenneth Franzheim, Consulting Engineers: Bernard Johnson & Associates, Electrical Contractor: Howard P. Foley Co.

MARCUS

TRANSFORMER CO., Inc.

RAHWAY, NEW JERSEY

Representatives in Principal Cities

"Mark of Quality"

A COMPLETE LINE OF DRY TYPE AND LIQUID-FILLED TRANSFORMERS THRU 5000 KVA

Martyn Ashby, Evansville Electric & Manufacturing Co., Evansville, Ind.; Robert F. Bozarth, Klein Armature Works, Centralia, Ill. and Walter Brush, Electric Motor Service, Birmingham, Ala., at NISA Convention in Philadephia.

NEMA's Lighting Section Meets in Atlantic City

Keying their activities to utility industry forecasts that sales of kilowatt-hours for lighting can reach 800 billion by the year 2,000, "if lighting receives continuous, all-out hard-hitting promotion," representatives of companies affiliated with the Industrial and Commercial Lighting Equipment Section, National Electrical Manufacturers Association, met in Atlantic City last month to review the progress made so far by their National Lighting Bureau toward this goal.

L. C. Messick, manager of the Bureau, reported that the project's Certified Lighting program is growing rapidly and is now in operation in 17 different major areas of the country. Each of the programs is conducted by a local Bureau jointly sponsored by utility companies,

PLANS FOR NALMCO's future were subject of discussion by Herbert Mendelsohn, (center) Kansas City, Mo., and Norman Meyer (left) and Edward Creed, both of Cleveland, during the Association's 3rd annual conference in Hershey, Pa. Creed is newly-elected president and Mendelsohn is new secy-treas.

ARTHUR L. HENDRICKSON, Duncan Electric Co., Duncan, Okla.; Paul Bach, Lubbock Electric Co., Lubbock, Tex., and William M. Hogue, Larson-Hogue Electric Co., Los Angeles, Calif., get together between Sessions at NISA convention in Philadelphia.

electrical contractors, electrical wholesalers, electrical dealers and all others interested in promoting adequate lighting installations in industrial plants, office buildings, schools and stores.

In a review of activities to date, Mr. Messick cited the accomplishments of four local lighting bureaus as examples of tangible results obtained of benefit to the electrical industry. These bureaus, he said, have brought to the utility companies which serve their areas a total of $139,450.56 in added revenue through the installation of their combined 360 certified lighting jobs. Included in such jobs were 16,749 lighting fixtures. The bureaus referred to are sponsored by the Electrical League of Rhode Island, Providence; Electric Institute, Inc., covering eastern Massachusetts, at Boston; San Diego Bureau of Home Appliances at San Diego, Cal., and Northern California Electric Bureau at San Francisco.

Ten of the local Bureaus have trained and graduated a total of 1,361 individuals from courses in which they have learned how to sell certified lighting. All of the bureaus plan additional courses.

C. R. Bartley, Bartley Electric Service, Wilmington, Del., and George Sachsenmaier, Keystone Power Plant Equipment Co., Philadelphia, Pa., at NISA's 23rd annual convention in Philadelphia.

Black & Decker® ELECTRIC HAMMERS ARE

POWER-BUILT to increase your output!

Up to 32 times faster than hand operation!

We don't buy motors—we build them!
The *heart* of your electric tool is the motor —completely built by Black & Decker. All the power you need *and then some*—because each motor is built for a specific tool and the job it must do. Black & Decker motors always *stand up!*
Accessories — star drills, bull points, concrete slotting tool, 4-point scaling tool, scaling chisels, cold chisels, flat wood chisels, bushing tools, seam tool and tool blanks.

With their built-in power, Black & Decker Electric Hammers can slash your labor costs and man-hours on hundreds of applications . . . increase your profits.

These hard-driving units drill, chip, channel, caulk, chisel, break, dig, gouge, peel, pierce, point and shape a variety of materials—brick, stone, masonry, concrete, wood, metal and earth. Four hammer models: ½", ¾", 1⅛" and 2", are typical of the complete B&D line of *Power-Built* electric tools—designed to speed work and shrink costs. See your B&D distributor or write: THE BLACK & DECKER MFG. CO., Dept. 2307, Towson 4, Md.

SERVICE

One of 44 Black & Decker factory service branches is located "next door" to you. Staffed by experts to provide fast, efficient service, genuine replacement parts.

Look in the Yellow Pages under "Tools-Electric" for Nearest Distributor

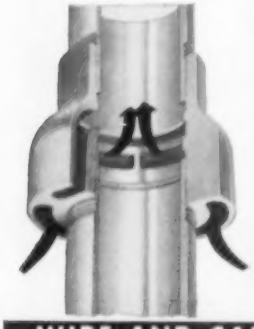
Black & Decker®
PORTABLE ELECTRIC TOOLS

Cool way to add cable life

CONDUIT VENTILATING CABLE SUPPORTS FROM PLM

PLM Type CV Ventilating Cable Support for use at top of conduit where cable extends into air.

PLM Type BCV Ventilator for use at bottom of conduit.



● Cable risers in non-ventilated conduit often build up temperatures which can shorten service life. PLM Ventilating Cable Supports provide support for risers in conduit, but permit escape of heated air ...materially reduce temperatures...increase service life...provide increased load-carrying capacity.

Types for base and top of new or existing installations, with or without flanges for supporting potheads. Write for catalog and prices.

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WIRE AND CABLE FITTINGS AND ACCESSORIES

Armored Cable Terminators • Splicing and Terminating Kits • Conduit Ventilators

. . . complete lamp protection with *Adalet* vapor-tight lighting

Inside or outside, wherever the lighting need, get better protection, greater safety with Adalet vapor-tight and weather-proof lighting.

From junction box to reflector, globe and shock-proof guard (that can't shake off), Adalet has a complete line . . . quality built for rugged service, engineer-designed for better lighting. 100, 200 and 500-watt sizes. Get the whole story — send for Catalog Section E.

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SHALLOW DEEP 30° ANGLE

WIRING FLEXIBILITY

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THE *Adalet* MANUFACTURING COMPANY

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Robert Johannesen Receives McGraw Award

The Electrical Distributors Medal and Purse under the James H. McGraw Award for Electrical Men was conferred upon Robert M. Johannesen, president, Johannesen Electric Co., Inc., Greensboro, N. C., at the opening session of the annual convention of the National Association of Electrical Distributors in Atlantic City last month.

Mr. Johannesen received the award for his devoted efforts toward identifying the essential functions of the electrical distributor in the economy and bringing broad recognition to his industry from all phases of commerce.

The judges who recommended Mr. Johannesen were Herbert Metz, Graybar Electric Co., Inc.; D. Lyle Fife, Fife Electric Supply Co.; John M. Newton, Sr., Oakes Electrical Supply Co.; and Titus B. Schmid, Crescent Electric Supply Co.

Electric Heat: 3 Million Homes by 1966

An increase in electric heating as the sole means of heat from today's 300,000 dwelling installations to 3,000,000 by 1966 was predicted by the Electric House Heating Equipment Section of the National Electric Manufacturers Association at a press conference in New York City last month.

Section Chairman R. E. Pequignot, vice-president and general manager of the Electromode Division of Commercial Controls Corp., introduced NEMA's new color sound-slide film, "Heat Your Home Electrically." The film emphasized the very practical aspects of electric heat, how it works, its many advan-

tages, and an analysis of installed and operating costs.

Elaborating further, Mr. Pequignot stated that electric heating installations cost no more and often cost less than fuel-burning systems. It was pointed out that, with more and more utilities offering favorable rates (1 to 2 cents per kw hr), operating costs are competitive on a "fuel-for-fuel" basis over a larger portion of the country.

Manufacturers displaying new models of their heating equipment saw a great new market in existing homes as well as new homes. Extensive remodeling or addition of extra rooms often finds the old heating system inadequate—a natural opportunity for electric heat. Farmers are using electric heat to heat their homes, barns and milk houses, and to prevent freezing of pump house pipes. In business and industry, electric heating is making rapid strides in motels, filling stations, loading docks, guard houses and small factories.

It was pointed out that electric heating can mean a considerable increase in business to the electrical contractor, house-heating contracts bringing compensations three times as large as those involving fuel heating systems.

The conference represented the beginning of a national promotion program by leading electric heating manufacturers.

NISA News

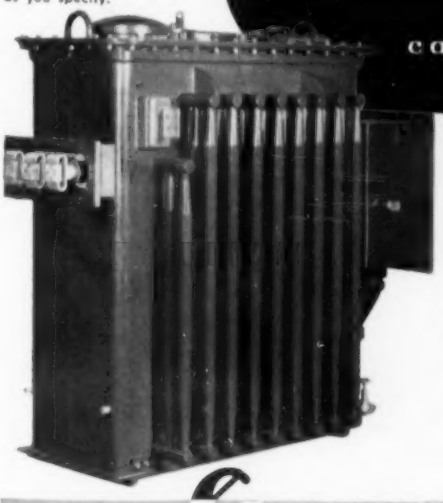
The May 12 tornado which struck Flint, Mich., seriously damaged the Dudley Electric Works, owned by new NISA director Joseph F. Dudley. Mr. Dudley was in Philadelphia for his first director's meeting, prior to the Association's 23rd Annual Convention, which opened the

RALPH W. TROBAUGH, Egle-Trobaugh Electric Co., Memphis, Tenn.; and James E. Dey and George R. Lockwood, Lockwood's Electric Motor Service, Trenton, N. J., get together between sessions at recent NISA convention in Philadelphia.

Standard Type HT Askarel-Filled, Non-Submersible Network Transformer. 300 KVA—13,200 to 120/208 volts, 3-phase. Special electrical and mechanical interlocks between high-voltage switch and no-load tap-changer switch handle. Can be equipped as you specify.

When a transformer application stumps you

call **STANDARD**



Standard engineers will work with you to produce the exact transformer required for your needs. Special components required to meet your application are incorporated as you specify. Let us show you how we can develop a custom transformer for you at no greater cost than a stock model. Write or call Standard today.

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THE STANDARD TRANSFORMER COMPANY

WARREN, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

REPORTS ARE POURING IN FROM EVERYWHERE—

"The Barth Cable Puller is the greatest thing that has hit the industry in 30 years!"

"Saves our men many hours of back breaking labor! Paid for itself in a week!"

Don't waste precious skill on old fashioned back breaking methods of pushing tape and pulling wire. Put a Barth Cable Puller to work **NOW** pushing tape and pulling wire the modern Barth way — electrically!

THE BARTH CORPORATION, 12664 Brookpark Road, Cleveland 30, Ohio

Please send complete Cable Puller data folder and prices.

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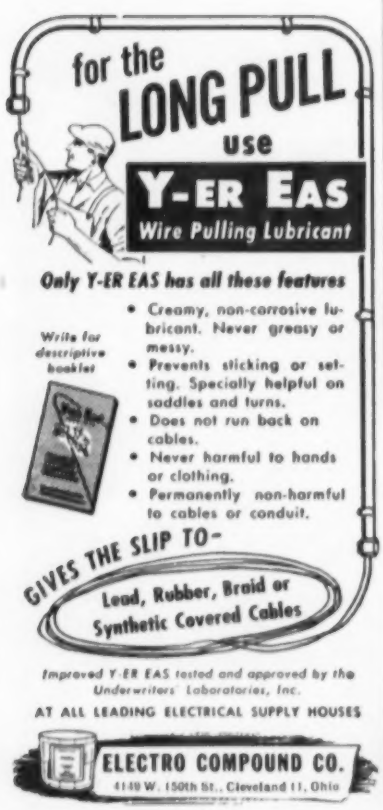
CONTRACTORS
THERE IS A
BIG DIFFERENCE!
Those who HAVEN'T
and those who
HAVE
1. Realize big savings in labor and materials; less cutting, threading or welding.
2. Turn out better, neater work.
3. Their work is longer lasting, leakproof, has less obstruction or headloss.
because:
4. They use TAL ONE SHOT BENDERS, hand operated or motorized. They make bends up to 180° in one setting, eliminating the use of fittings or elbows and couplings.
WRITE FOR TRIAL AT NO CHARGE to:
Tal Bender, Inc. Dept. 21 Milwaukee 2, Wis.


for the
LONG PULL
use
Y-ER EAS
Wire Pulling Lubricant
Only Y-ER EAS has all these features
• Creamy, non-corrosive lubricant. Never greasy or messy.
• Prevents sticking or setting. Specially helpful on saddles and turns.
• Does not run back on cables.
• Never harmful to hands or clothing.
• Permanently non-harmful to cables or conduit.
Write for descriptive booklet
GIVES THE SLIP TO—
Lead, Rubber, Braid or Synthetic Covered Cables
Improved Y-ER EAS tested and approved by the Underwriters' Laboratories, Inc.
AT ALL LEADING ELECTRICAL SUPPLY HOUSES
ELECTRO COMPOUND CO.
4140 W. 150th St., Cleveland 11, Ohio

next day. He and Mrs. Dudley drove back to Flint, where he spent the next seven days cleaning up the debris which had covered his shop. Fortunately the tornado, which leveled all neighboring buildings in the block, hop-skipped the Dudley structure, leaving the year-old concrete-and-steel building standing. The owner's business interruption insurance saved him from financial loss.

• • •

NISA's National Headquarters has moved into larger offices, on the 11th floor of the Paul Brown Building in downtown St. Louis, one floor below its former 12th floor suite. The new quarters contain larger, more private offices for the executive secretary and staff engineer, a reception area for visitors, a mail room several times larger than the old facility and a separate library-conference room. The Association's mailing address remains 818 Olive St., St. Louis 1, Mo.

• • •

NISA has made arrangements for members to order two-color, imprinted book matches through National Headquarters. More than 30 shops have already taken advantage of the opportunity.

• • •

NISA's new national vice-president, Alfred Elson, Jr., president of the New England Machine & Electric Co. of Pawtucket, R. I., was recently honored by his city's Boy's Club, receiving the organization's Alumni Award for his work "in behalf of youth and the community."

• • •

Another Nisan recently honored by his community is Edward G. Potter, former Association director and manager of the Lima (Ohio)

EARL D. JOLLEY, JR., Elec-Mech. Service Co., Elyria, Ohio, and Frank W. Ross, Ross Electric Motor Shop, Fairmont, Minn. at the convention of the National Industrial Service Association in Philadelphia.

C. CORTLAND WORTH, Erie Electric Co., Inc., Buffalo, and Ralph Barker, Barker Electric Co., Niagara Falls, N. Y., were two of the 1345 delegates attending NISA's 23rd annual national convention in Philadelphia.

Armature Works, who was elected president of the Lima Rotary Club.

• • •

NISA's Award Contest Committee is urging members to send in entries for the 1957 Award Contest now. Several entries received too late for the recently concluded 1956 contest are on file. The contest offers a total of $350 in prizes, including a first prize of $100. Prizes are also offered to NISA chapters with the most winners and the most entries.

• • •

New officers of the Northwest-Central Ohio Chapter of NISA include: President, Charles K. Glass of Glass Electric Motor Service, Springfield, Ohio; secretary, Bob Bruce of Lima (Ohio) Armature Works; and Elmer Girkins, Girkins Electric Co., Toledo, Ohio, treasurer.

• • •

New officers of Oregon Chapter include: President, E. T. Kalen of Kalen Electric & Machine Co., Eugene, Ore.; vice-president, Curtis Johnson of Marine Electric Co., Portland, Ore.; and J. C. Reed of Reed Electric Co., Portland.

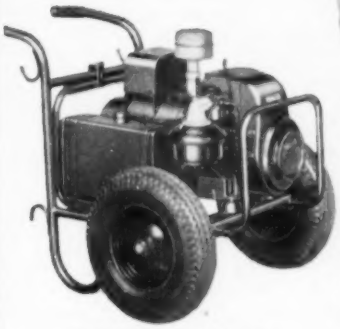
• • •

The first meeting in the state of Oklahoma for NISA's Southwestern Chapter will be held at the Biltmore Hotel, Oklahoma City, Sept. 20-22.

• • •

Gordon Kunde of Benson Electric Motor, Brainerd, Minn., is the new president of North Central Chapter. Other officers are: vice-president, James J. Anderson of A&P Electric, St. Paul, Minn.; secretary-treasurer, Fred Davenport,

KOHLER Electric Plants
for on-the-job electricity anywhere, anytime



Portable, low-cost Kohler Electric Plants cut work time. Save expense and delays of temporary power-line hook-ups. Operate floodlights, saws, drills, other tools used in wiring jobs. Engineered by Kohler throughout. Two-wheel, rubber-tired hand cart available. Sizes 500 watts to 35 KW, maintain home, public or commercial electrical equipment when central station power is cut off. Write for booklet H-25.

Model 2.5M25, *2500 watts, 115 volt AC. Manual starting.*

Kohler Co., Kohler, Wisconsin
Established 1873

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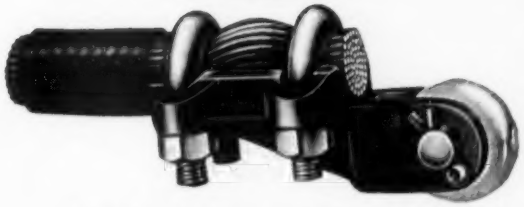
PLUMBING FIXTURES • HEATING EQUIPMENT • ELECTRIC PLANTS
AIR-COOLED ENGINES • PRECISION CONTROLS

LOCK CABLE SAFELY, SECURELY *with*—
"EFFICIENCY" Cable Strain Clamps
without Strain or Damage



. . . Withstands direct pull of 17,000 pounds

Efficiency Cable Strain Clamps lock cable safely and securely without possible strain or damage. "H" construction of clamps and high ridge across center of cable prevents cable from slipping. Takes cable from 1/0 to 1,500,000 c. m. Three clamp sizes cover all cable sizes. Furnished with eye or clevis, for AC or DC Service.

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Efficiency ELECTRIC AND MANUFACTURING CO.
EAST PALESTINE, OHIO

MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT AND WIRE CABLE SUSPENSION

NOW!
an uplight component in mercury high bay lighting

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24" ALUMINUM UPLIGHT LUMINAIRE

. . . another exclusive ABOLITE development. The new ABOLITE 24" aluminum UPLIGHT LUMINAIRE was specifically designed for the H400-RC1 color improved mercury reflector lamp. This new luminaire is also used successfully with 1000 watt mercury lamps.

Unique open top design results in 18% uplight with H400-RC1, and 16% with H1000-C15 lamps.

ABOLITE UPLIGHT LUMINAIRES produce more comfortable lighting by reducing brightness contrasts between the lamp and the ceiling and upper walls. In addition, improved shielding provided by the luminaire further reduces glare. Lamps are kept cooler because excessive heat escapes through top, thereby increasing lamp life.

WRITE NOW FOR COMPLETE DATA

GOLDEN ANNIVERSARY 1906 1956
SUSTAINING MEMBER

ABOLITE Lighting DIVISION
THE JONES METAL PRODUCTS CO.
WEST LAFAYETTE, OHIO

Lackore Electric Motor Repair, La-Crosse, Wis.

• • •

NISA's Quaker City Chapter, after its months of work on the recent Philadelphia Convention, relaxed at a social meeting at Lu Lu Temple Country Club June 22.

• • •

Chicago Chapter (Central District Chapter of NISA) has adjourned for the summer. Its next meeting will be held Sept. 11.

• • •

Busy Electric Co. of Tallulah, La., has moved its shop to the nearby community of Vicksburg, Miss.

• • •

Ontario Chapter met June 2 at Sevens Dwarfs Inn, London, Ont. The organization's next meeting will be held in September when members of Niagara Chapter will be invited. Time and place will be announced later.

• • •

Greater Cleveland Chapter met May 21 at the Manger Hotel. Several members reported on the Philadelphia Convention.

• • •

Los Angeles Chapter met June 12 at Rodger Young Auditorium to hold a discussion on training of motor winders and repair men. The discussion was led by James Mason, a member of the Los Angeles Trade-Technical Junior College staff.

• • •

New England Chapter met June 14 at Hotel Bradford, Boston. The chapter's next meeting will be held in September.

HENRY Z. LANG, Lang Electric Co., Buffalo, N. Y. and Harry J. Edwards, T. H. Green Electric Co., Rochester, N. Y., discuss one of eight technical papers presented at NISA convention.

A NEW TOOL FOR CONTRACTORS

The Wodack organization is observing its 40th year of electric tool manufacturing by offering a new labor saving tool to contractors and maintenance departments.
The new Wodack ® Plaster Groover is for men whose work requires grooving, cutting and repairing plastered walls, such as underplaster wiring and running copper oxygen tubing. A great improvement over the hammer and chisel method and other makeshift tools.
It's made in two models, one with 4-inch abrasive cutting wheels, and the other with a 6-inch cutting wheel. Both models are equipped with vacuum cleaner connections, for collecting dust and grit. No need to clear the room for alteration work.
This tool opens new jobs to contractors. Read about them in the new Bulletin 560-EC. Also complete descriptions of the two models. Don't delay. Plaster groover jobs are not seasonal. They can be done the year round.

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This

SWIVEL U-BOLT CONNECTOR

is designed to do just that . . .

No Removable Parts
Easily and Speedily Installed
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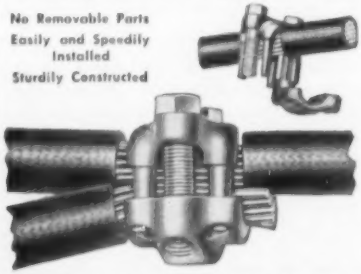

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EXPANDED METAL TROUGH
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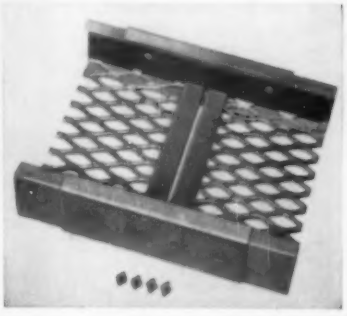

P-W provides a strong, versatile and well-grounded system. Channel Connectors with drive rivets are quick and easy to assemble—various lengths and Extension Connectors eliminate field cutting—Adjustable Horizontal and Riser Connectors meet required changes in direction and elevation—supplied in widths from 1" to 24" and lengths from 1' to 16'—Hanger rods or

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DATES AHEAD

International Association of Electrical Inspectors — Southern California Chapter—Santa Monica, July 25; **Southern Section**—Conrad Hilton Hotel, Dallas, Texas, October 22-24.

International Association of Electrical Inspectors — Section meetings: **Northwestern Section** — Newhouse Hotel, Salt Lake City, Utah, Sept. 10-12; **Southwestern Section**—Hotel and city to be announced, Sept. 17-19; **Western Section**—Statler Hotel, St. Louis, Mo., Sept. 24-26; **Canadian Section**—King Hotel, Toronto, Ontario, Canada, Oct. 12-13; **Eastern Section**—Wentworth - by - the - Sea, Portsmouth, N. H., Oct. 15-17; **Southern Section**—Statler - Hilton Hotel, Dallas, Texas, Oct. 22-24.

Illuminating Engineering Society—National Technical Conference, Hotel Statler, Boston, Mass., Sept. 17-21.

Instrument Society of America—Eleventh Annual Instrument Automation Conference and Exhibit, New York Coliseum, New York City, September 17-21.

National Industrial Service Association—Southwestern Chapter, Biltmore Hotel, Oklahoma City, Okla., September 20-22; Central District Chapter, Chicago, Ill., September 11.

National Electrical Contractors Assn. 55th Anniversary convention and Second National Electrical Exposition, Sheraton-Palace Hotel, San Francisco, Calif., September 23-29.

National Electronics Conference—Hotel Sherman, Chicago, Ill., Oct. 1-3.

International Association of Electrical Leagues — 21st annual conference, Sheraton - Cadillac Hotel, Detroit, Mich., October 3-6.

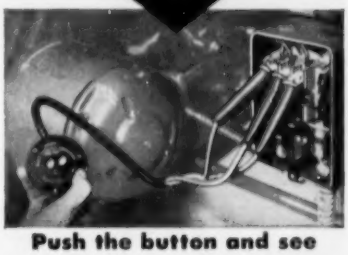
National Electrical Manufacturers Association — Annual meeting, Traymore Hotel, Atlantic City, N. J., November 12-16.

22nd National Exposition of Power and Mechanical Engineering—Coliseum, New York City, November 26-30.

LIGHTING MAINTENANCE service methods ideas were exchanged by (l. to r.) Sam Feldman of Boston, John H. Shaver, Jr. of Akron, and William M. Reister, of Pittsburgh, during recent annual conference of the National Association of Lighting Maintenance Contractors, held at the Hershey Hotel, Hershey, Pa.

have correct 3-phase connections with the

KNOPP PHASE SEQUENCE INDICATOR



Push the button and see the Sequence 60—600 V.

No adjustments required for readings

You just clip on the Knopp Phase Sequence Indicator, push the safety button and you are sure whether the phase sequence is A-B-C or C-B-A.

This new model K-3 Knopp Phase Sequence Indicator, like the previous models, shows phase sequence by direction of disc rotation rather than by lamps. Gives correct indication regardless of voltage or circuit conditions without changing taps or dials. It protects equipment and assures properly connected polyphase wiring; all voltages between 60 and 600, 3 phase, 3 wire 25-60 cycles. May be used on frequencies up to 400 cycles on the higher voltages.

Light Weight, Compact, Small

It stands up under rough field use and gives accurate and reliable service. It is made by Knopp Inc., technical electric equipment manufacturers of 28 years' experience. This indicator has a laminated bakelite housing and no exposed metal parts. It is built for complete safety. Fully insulated clips can remain attached between tests as safety push button permits indication only when needed. Weighing but 21 oz., the Knopp Phase Sequence Indicator is small and easy to carry. Price $29.25; leather carrying case, $5.85 additional. Order this improved Model K-3 today or write for complete description.

KNOPP Voltage Tester

For easier, safer, faster testing use the Knopp Voltage Tester. Gives magnitude of voltage between 110 and 600; a-c or d-c, pure or rectified; 25 or 60 cycles. See your dealer or write for illustrated free, descriptive Bulletin No. 425.

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Founded in 1928 by Otto A. Knopp under the name of Electrical Facilities Inc.

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WILEY Offers:
STARTER TYPE,
RAPID START
AND
SLIMLINE
LIGHTING FIXTURES
Commercial
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Since the inception of fluorescent lighting, Wiley has been producing fixtures to one standard only—the highest quality obtainable.

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Wiley lighting engineers design fixtures that are simple, clean-lined to fit any architectural plan of lighting; that are economical, easy to install and maintain.

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Among the Manufacturers

Headquarters Announcements

Burndy Engineering Co., Inc., Norwalk, Conn.—I. F. Matthyse, chief engineer of the utility-industrial division.

American Steel & Wire Div., U. S. Steel Corp., Cleveland, Ohio —Maxwell D. Millard, general manager of sales.

General Electric Co., Bloomfield, N. J.,—R. H. Jones, general manager of the air conditioning division.

Berns Air King Corp. is the new name of the Berns Mfg. Corp. of Chicago, Ill.

Thomas Industries, Inc., Louisville, Ky.—Frederick Keller, vice president.

Air Reduction Co., Inc. has relocated to 150 E. 42nd St., New York, N. Y.

General Switch Corp., Brooklyn, N. Y. has changed its name to General Switch Company Division of Norbute Corp. as the result of a merger with that firm.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.—G. E. Seidel, vice president in charge of engineering.

T. J. Cope, Inc., Collegeville, Pa. —Fred Ullberg, Jr., vice president in charge of sales for the Instrof Division.

Simplex Wire & Cable Co., Cambridge, Mass.—John T. Blake, vice president.

Penn-Union Electric Corp., Erie, Pa.—Morris Brenner, chief engineer.

Stonco Electric Products Co., Kenilworth, N. J.—W. B. Mayer, marketing-director.

W. H. Brady Co., Milwaukee, Wis.—Thomas B. Wise, general sales manager.

S & C Electric Co., Chicago, Ill. —Harold H. Fahnoe, manager-administrative engineering.

Electric Storage Battery Co., Philadelphia, Pa.—E. J. Dwyer, vice president.

Cutler-Hammer Inc., Milwaukee, Wis.—W. F. Lent and R. A. Millermaster, vice presidents.

Bryant Electric Co., Bridgeport, Conn.—C. J. Smith, manufacturing manager for plastics division; J. K. Adams, will hold the same position in the wiring device and appliance controls division.

General Electric Co., Pittsfield, Mass.—Boyd W. Bullock, manager

It doesn't Cost... it Pays to use...

HELWIG CARBON BRUSHES

Brushes are manufactured to size — need not be cut down to fit commutator. It pays to protect your electrical equipment with HELWIG CARBON BRUSHES.

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CARBON PRODUCTS
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NOW! Bend Conduit ...fast and Accurate

RUGGED PORTABLE PIPEBENDER FOLLOWS THE JOB... WORKS IN ANY POSITION

ALL STEEL CONSTRUCTION
FASTER THAN HYDRAULIC
MAKES 180° BENDS... COMPLETE MACHINE...
NO LOOSE PARTS...
PORTABLE—66 LBS.*
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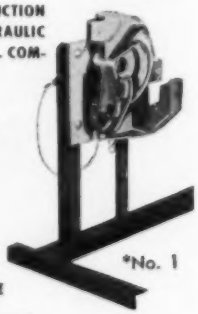
...NO MAINTENANCE
BUILT IN SQUARE AND SCALE FOR CHECKING BENDS.



LOWEST COST, MOST EFFICIENT UNIT AVAILABLE

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ASK YOUR SUPPLY HOUSE

The CHICAGO Bender will make your work easier... the No. 1 shown bends ½", ¾" and 1" in 2", 4" and 5½" radii. No. 2 bends 1¼" and 1½" pipe in 7" and 8½" radii. Both are also made for Thin Wall conduit.

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One Fixture Cost . . . One Installation Cost

NEO-RAY ROTO-STRIP
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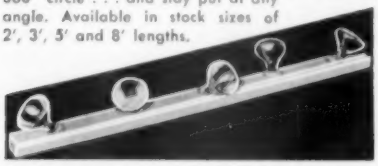
FLOODLIGHTING PLANT AREAS

ROTO-STRIP provides adequate, inexpensive lighting for plants. May be placed on ceilings, trusses, beams, walls, floors, platforms, etc. Used by leading corporations throughout the country.

ROTO-STRIP is a complete shallow unit (available for surface, corner or recessed mounting) with built-in recessed roto sockets that swing 90° in all directions through a complete 360° circle . . . and stay put at any angle. Available in stock sizes of 2', 3', 5' and 8' lengths.

Surely Roto-Strip has a place in your plans.



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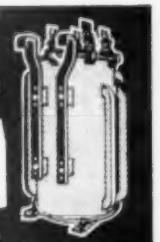
TRANSFORMER HANGERS



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THIEL EASY-DRIVE FASTENERS
FOR ELECTRICIANS . . . REFRIGERATOR MEN PLUMBERS

Easy Drive STAPLES

NEW "GRIP TYPE" Easy-on STRAPS

ANOTHER FIRST FOR THIEL — NEW HUMP THIEL PAT. PENDING — Easy Drive NAIL-IT STRAPS

• Essential for Electrical Men
• Greatest Improvement in 50 Years

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EMERY M. DEUTSCH, Continental Electric Co., Inc., Newark, N. J., and Henry Almaras, Tirest Electric Co., Long Island City, N. Y., attended the recent convention of NISA, held in Philadelphia.

of marketing for laminated and insulating products dept.

Graybar Electric Co., Inc., New York, N. Y.—J. P. Lawton and John Reine, elected members of the board of directors.

Line Material Co., Milwaukee, Wis.—W. V. Swan, product manager for Permaline Fiber Glass products.

Distribution Assemblies Dept., General Electric Co., Plainville, Conn.—H. D. Kurt, manager-product planning.

Thor Power Tool Co., Aurora, Ill.—J. R. DeBacher, vice president.

General Electric Co., Erie, Pa.—The dc motor and generator dept has been realigned to include three new product sections. Managers of these sections are: Lyman E. Sproul, speed variators and small dc motors and generators; P. S. Stough, medium dc motors and generators; and F. J. Boucher, aircraft and specialty motors and generators.

Regional Appointments

MIDDLE ATLANTIC

Kaiser Aluminum & Chemical Corp.: New York City offices relocated to 300 Park Ave.

Century Electric Co.: Gunar Moe, district manager for New York office.

C & D Batteries Inc.: William H. Krapf, Pittsburgh, Pa., sales representative.

Edison Electric Storage Battery Div.: Robert H. Weeks, Jr., New York district manager.

EAST CENTRAL

Electro Silv-A-King Corp.: Charles Turbyville, Knoxville, district representative for central and eastern Tennessee.

Miller Co.: William N. Hancock,

USE A PRODUCT YOU SHOULD KNOW MORE ABOUT.

"MULTI-DIAMETER"
(LEAD ALLOY)
WOOD SCREW ANCHOR

FOR GREATER SUSTAINED HOLDING POWER IN SOLID WALLS.

The U. S. E. Multi-Diameter is cast in one piece with radial slots running from the collar to the end of the anchor on opposite sides, thereby splitting the anchor in two halves. These two halves are made with a tapered, rectangular hole through which the wood screw is turned, cutting its own threads. As the screw advances, it not only splits the two halves apart but also tends to shift and spread them sideways in opposite directions, making 4 points of pressure contact instead of the usual two.

THE RESULT IS TWICE THE HOLDING POWER OF ORDINARY WOOD SCREW ANCHORS.

U. S. E. Products are sold through *recognized dealers only.*

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MINERALLAC 2-HOLE
PIPE STRAPS
For Heavier Loads!

Two-hole pipe straps of zinc plated steel. Double ribbed and embossed for lock washer action to support heavier pipes, cables, conduits, etc. Available in sizes to fit pipe and conduit from ¼-inch to 6-inch. Also available in Everdur, copper or aluminum.

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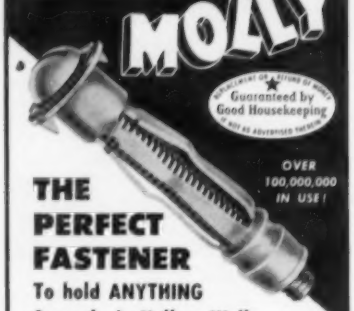
Guaranteed by Good Housekeeping



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THE PERFECT FASTENER
To hold ANYTHING Securely in Hollow Walls, Floors and Ceilings

Unlike nails and screws, Molly allows you to install fixtures securely and exactly where you want them—not where studs are. Molly ends loose fixtures, crumbled plaster, broken walls. Molly reinforces the area in which used, won't pull through. Unlike other types of fasteners, Molly anchorage is permanent—fixtures can be removed and replaced in the same anchor. Molly is inexpensive and money-back guaranteed.

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MODEL B-7 MEGOHMER

COMBINED PRECISION OHMMETER & MEGOHMMETER
0-20, 0-200 MEGOHMS. 0-200, 0-20,000 OHMS.
Reads as low as 1/10 of 1 Ohm to as high as 200 Megohms. 2 Test Potentials 250/500 Volts. No cranking, no wavering of pointer. Saves time and effort. Simplifies Insulation Testing. Ideal for low resistance testing too.
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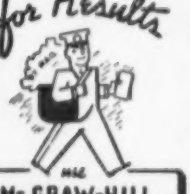

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Youngstown Sheet & Tube Co.: R. P. Broadhurst, Chicago district sales manager. C. H. Jones, manager of Dallas, Texas sales district.

Pittsburgh Reflector Co.: R. J. Kuzel, Jr., sales and service engineer for northern Illinois.

Lima Electric Motor Co.: Anthony N. Pellegrini heads new sales office at 6432 Cass Ave. in Detroit, Mich.

Century Electric Co.: John B. Heil, acting district manager at Birmingham, Ala.

Sylvania Electric Products Inc.: Charles A. Burton, regional sales vice president for the Middle West, headquarters in Chicago.

KSM Products, Inc.: M. L. Sundeen, district engineer for the stud welding division in Michigan, Ohio and Indiana with offices in Detroit.

WEST CENTRAL

Miller Co.: Paul A. Crick, north Texas representative; J. J. Poniske, sales representative with Custer & Co., agency for the St. Louis area; Richard J. Slattery, Iowa-Nebraska territorial representative.

Electric Service Mfg. Co.: Everett G. Parmele, Dallas, representative for Texas, Oklahoma, New Mexico and Arkansas.

C & D Batteries Inc.: Devon D. Gilman, service representative for Dallas, Texas area.

Orangeburg Mfg. Co., Inc.: Carl F. Arnold, north central district sales manager covering Nebraska, Kansas, Missouri and the Dakotas.

Line Material Co.: Maury A. Babin, field engineer for southeastern Texas with offices in Houston.

WEST

Consolidated Diesel Electric Corp.: E. M. Reinhorn, West Coast sales engineer for industry test equipment, offices in Los Angeles.

Leadlight Fixture Co.: Robert E. Gordon, sales engineer for northern California.

Edwards Co., Inc.: Richard A. Vaill, western regional manager of sales in ten western states and Hawaii.

C & D Batteries, Inc.: S. J. Mahurin, Los Angeles sales representative.

Gem Electric Co., Inc.: Guy de Leuze Co., sales representative for northern California and northern Nevada, offices in San Francisco.

Line Material Co.: New sales office and warehouse has been opened at East 3303 Ferry St., Spokane, Washington.

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For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

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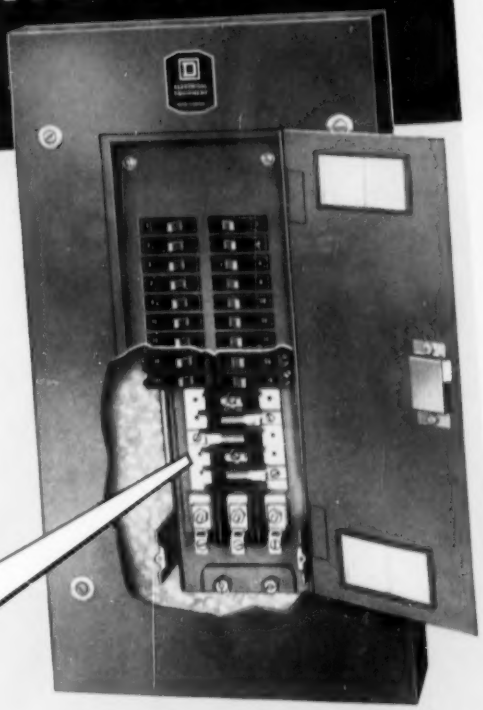
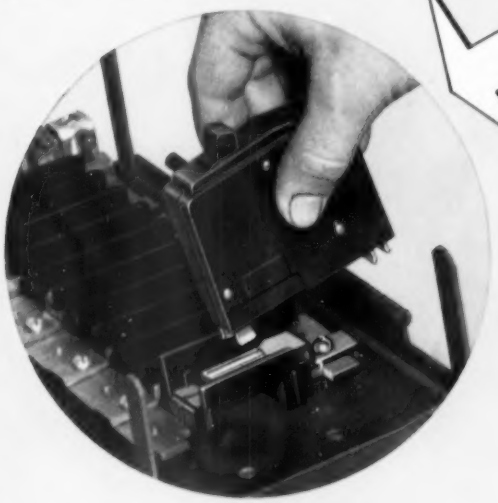
with QO... FINEST BREAKER EVER BUILT!



...Get the complete line "Off-the-Shelf" from your Electrical Distributor or have assembled panels shipped right to the job

It's a top quality line throughout! Note the compact, streamlined beauty. A closer look reveals such outstanding features as: Distributed phase bus arrangement with clear identification for simplified load balancing. Adjustable, indicating trim clamps. Galvanized box with large gutters for real accessibility, yet compact enough to mount between 16" wall studs. Most important of all—the new NQO panelboard offers you the finest breaker ever built, with exclusive **SWINGRIP** mounting.



NEW QO BREAKER
with Exclusive SWINGRIP mounting

No other breaker has all these features which make QO the finest breaker ever built!

- Plug-In for maximum flexibility as well as ease of installation and maintenance.
- Quick-make, quick-break mechanism provides positive operation, has excellent "feel". Assures positive operation and long life under all circuit switching conditions.
- Compensated thermal trip enables breaker to carry full allowable load under varying ambient temperatures.
- Sensitive calibrated magnetic trip assures quick and consistent response to harmful overloads or short circuits.
- Non-interchangeable design discourages the use of 30, 40 and 50 ampere units where 15 or 20 ampere breakers have been installed.
- Trip indication on overload or short. Handle moves to middle position.
- Positive action of handle against contact members guarantees circuit opening.
- Compact design—¾" width for each pole conserves valuable space.
- Exclusive **SWINGRIP** mounting provides easier installation, automatic alignment, positive contact with bus bars.

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!

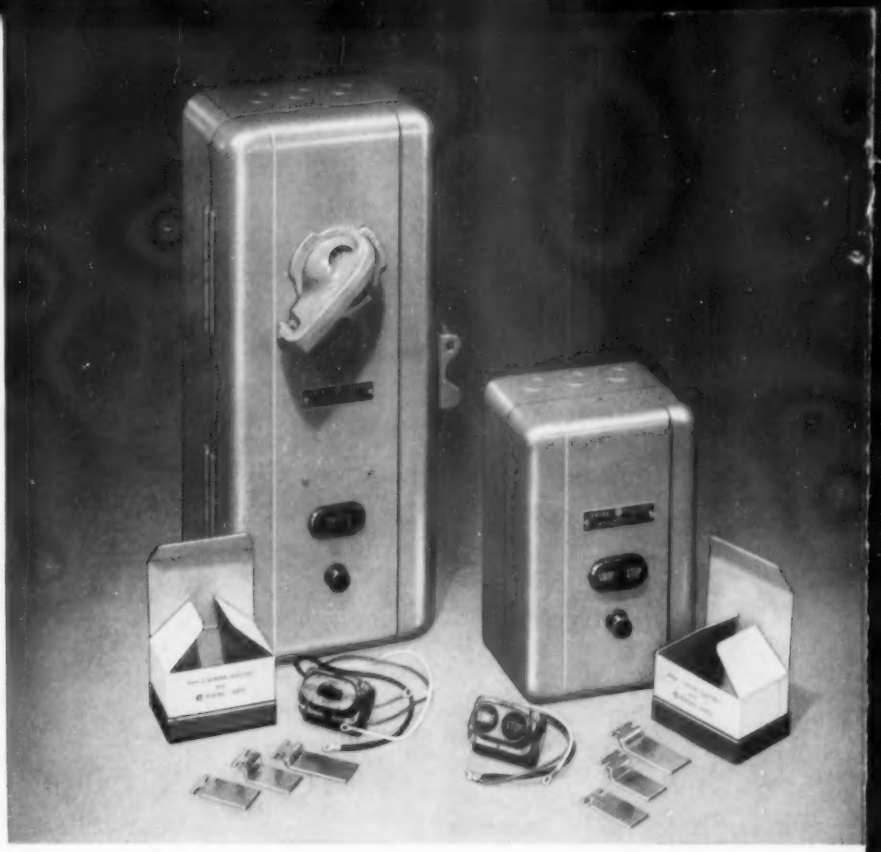
SQUARE D COMPANY

1 **Remove knockout** provided in covers of G-E starters. Knockout accommodates either push button or selector switch.

2 **Mount bracket** with two screws that hold armature stop. Select proper bracket from three provided in each kit.

3 **Mount push button,** or selector switch by slipping spring clip on back of unit over the bracket. Wire per diagram in kit.

4 **Position unit** to fit knockout. Adjustment is easy. Spring clip permits free movement of unit on mounting bracket.



TO MODIFY G-E STARTERS—

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Push buttons and selector switches for mounting in the covers of G-E magnetic starters are now available in kit form. Your G-E Distributor can give you off-the-shelf service on kits any time you need it. From now on starter enclosures will be furnished with a knockout in the cover. If you need to modify a starter, you can do it yourself quickly and easily.

The new kits can be used with all general-purpose non-reversing or combination non-reversing starters from Size 0 through Size 4. A single pushbutton or selector-switch kit will modify any one of these starters.

Installation is easy, as demonstrated in the photographs at left. Each kit contains a push button or selector switch, plus three mounting brackets. One of these brackets will fit the starter you plan to modify, and you simply discard the others.

No other accessories are necessary. Only two screws are used for mounting, and these are part of the starter itself. Leads are color coded for easy wiring, and diagrams are provided with each kit.

Full information on these modification kits is available from your General Electric Distributor. Contact him for details, or write to Section 733-9, General Electric Company, Bloomington, Illinois.

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